Science in Action for Boys and Girls 2

528

THE JUNIOR SCIENTIST

N. F. Newbury and H. A. Armstrong

Drawings by Gerald Wilkinson

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SCIENCE IN ACTION FOR BOYS AND GIRLS

BOOK ONE *The Young Experimenter*

BOOK TWO *The Junior Scientist*

TEACHER'S BOOK

N. F. Newbury, M.A., M.Sc., Director of Education, St Helens

H. A. Armstrong, Headmaster, Carr Mill County Primary School, St Helens

S.C.E R T., West Benga
Date
Acc. No.

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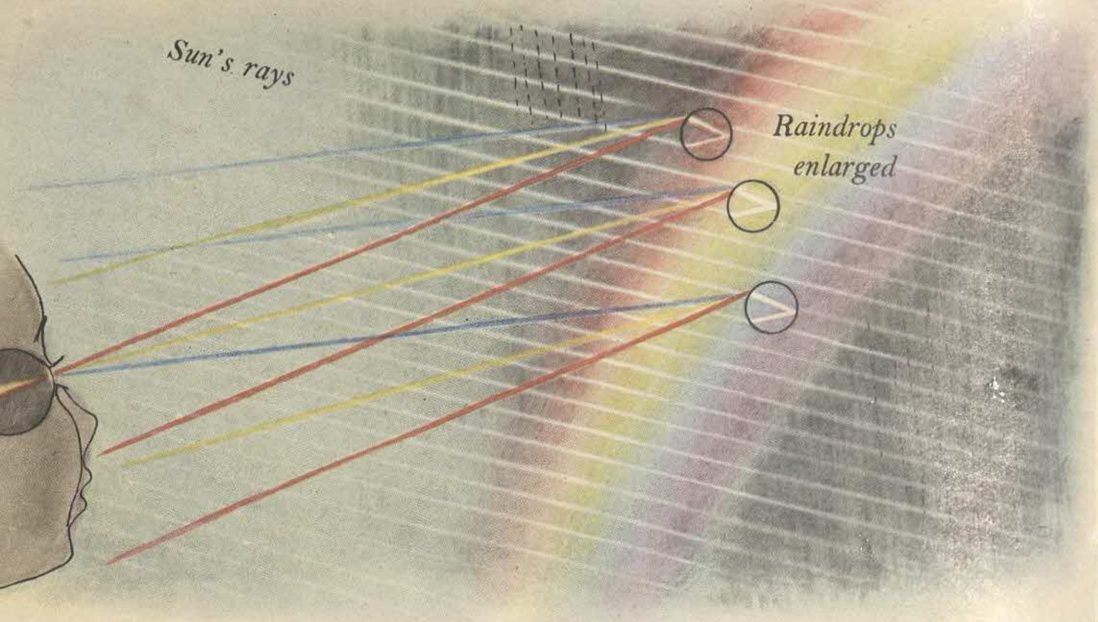
To boys and girls

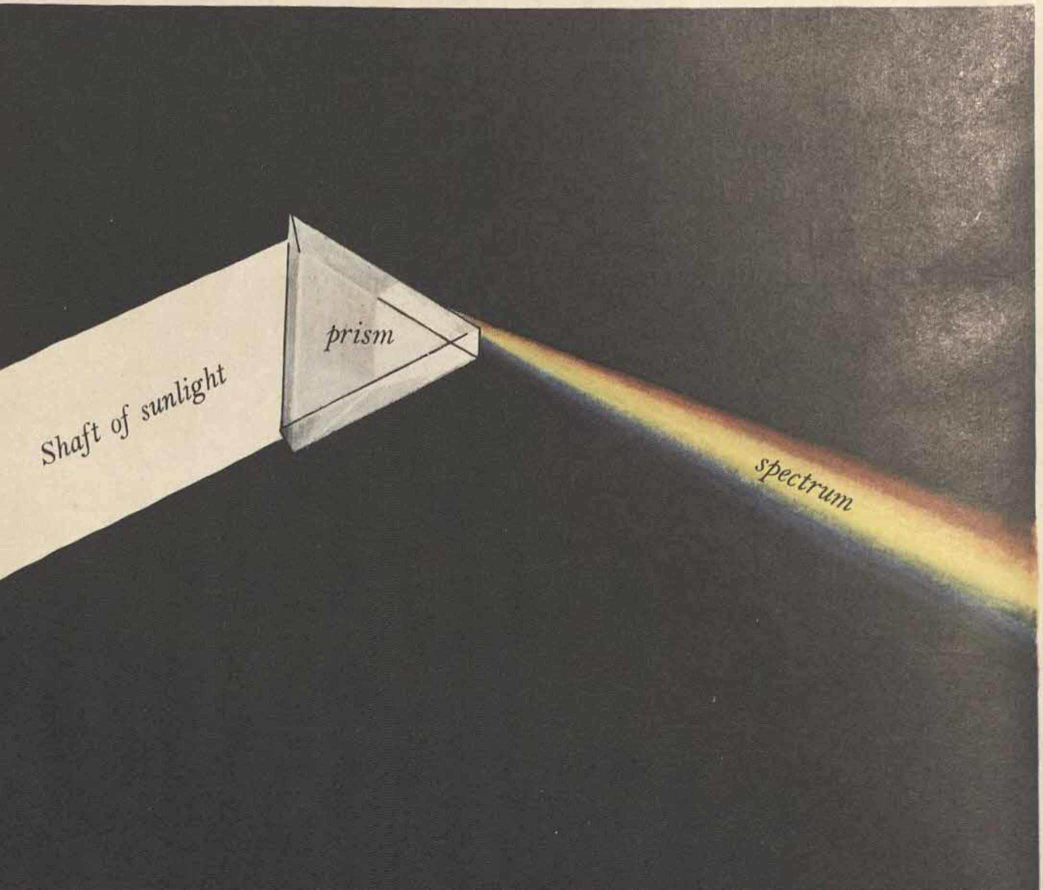
This is the second book in the Science in Action series, and we hope that it will help you in training to become a good scientist. Those of you who have worked through the first book will find many similar methods in this book. The work is divided into topics and the experiments are simply described so that you can usually carry them out yourselves.

Some of the topics you will be able to complete in a short time, but others will require experiment and discovery over a longer period, especially in the last few topics when you will be studying living things.

Remember that the most important thing is for you to discover for yourself, by doing the experiments, by observing carefully, by using reference books to find the answers to your problems. Do not ask a teacher or parent for help until you have tried in every way to find out for yourself and are really unable to solve the problem.

We hope that the methods described here will help you to work in the way that scientists do, and that your interest in learning about Science will help you in your work and in your leisure for many years to come.


Sun's rays
Raindrops enlarged


prism
Shaft of sunlight
spectrum

1 – *How light comes from the sun*

1 What is the difference between light from the sun and the light we get from the moon?

2 Where could you show a friend that beams of light travel in straight lines? (See Book One, page 90.)

3 How can you see behind yourself without turning your head?

4 What are the colours of the rainbow, in order?

Things to do

1 Look at the image of your face in a mirror, a bright tin, a large spoon (both back and front), a piece of bright metal, the flat surface of water, a round bottle filled with black ink, a polished table or a large ball-bearing. A reflection is called an image. Can you think of anything else which will reflect an image of your face? Are all the images you see the same?

2 Examine a mirror. Look at its back. Use your mirror to catch the bright rays of the sun and reflect them on to a wall. How must you tilt the mirror so that the ray of light from the sun is reflected to different corners? In what way does a ball, thrown at an angle to a wall and rebounding, resemble the ray of light? Look at yourself in the mirror. Touch your right ear with your right hand. Does your image seem to be doing something different? Move back from your mirror. What do you notice?

3 Try to borrow a really big mirror. Hold it so that it reflects a number of children in your class at various distances from

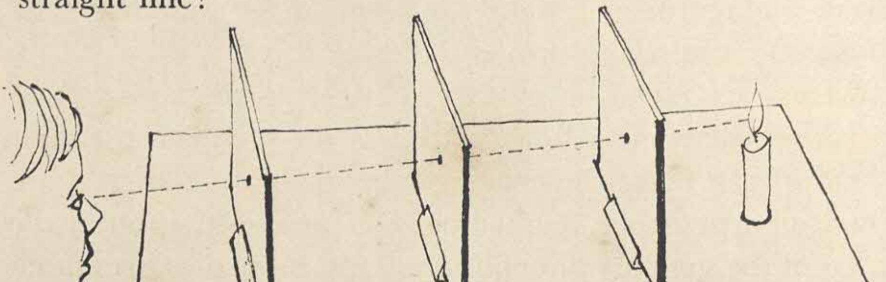
it. How many children can you see? Choose one of the children you can see. Can each child who can see you also be seen by you?

4 Stick your mirror in a piece of Plasticine so that it will stand up by itself. Print your name on a piece of paper and hold it in front of the mirror. Now print your name again but look in the mirror as you write. Draw the letter F and look at its reflection.

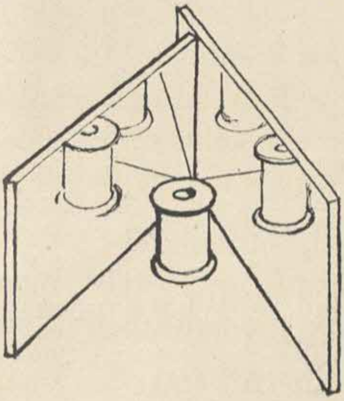
5 Look at the edge of a bevelled mirror in sunlight. Can you see the colours of the rainbow? Use a prism or a glass lustre in the same way. Try to get a band of colours on the floor by putting a glass aquarium filled with water on the sill of a window through which the sun is shining.

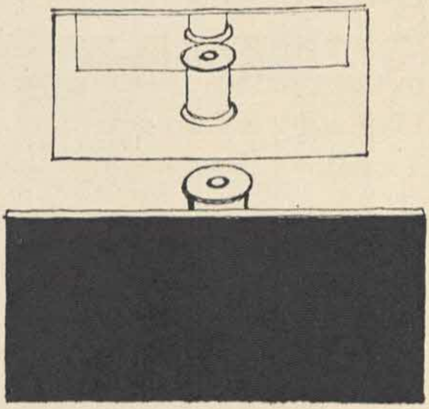
6 Take an apple, an orange and a torch into a dark room and experiment by switching the electric light on and off.

7 Take three rectangular pieces of cardboard and stick a nail through the centre of each of them. Stand each of them up with a piece of Plasticine so that the holes are in a straight line. Look through the holes at a lighted candle or torch held at the end. Now move one piece of cardboard to one side so that its hole is out of line with the other two. How does this prove that a ray or beam of light travels in a straight line?



8 Put two mirrors together in the way shown in the sketch. Place a small object between them and look in both mirrors. How many images can you see? Bring the mirrors closer together but keep the ends touching. How many images can you see now? As you bring the mirrors nearer to each other, do you see more or fewer images of your object? Now try with the mirrors at different distances and in different positions (for example, parallel to each other).





Things to remember

Light travels in straight lines. Smooth and bright things can reflect light and act as mirrors. In a mirror, you see your face as far behind the mirror as it is in front. In a mirror, things look the wrong way round; for example, your right arm and right ear seem to be your left. The image in a mirror is turned the other way.

Mirrors are useful on motor cars to show the approach of another car coming from behind. If the mirror is the right kind, it can make the image smaller or bigger. Mirrors are used in a periscope. Light from the sun is white, but if the rays of the sun pass through raindrops, they may form seven different colours which merge into each other. This is how a rainbow is formed. The colours are red, orange, yellow, green, blue, indigo and violet. Rainbow colours can also be seen when white light passes through a three-sided piece of glass. They can also be seen in a lustre, or on the edge of a bevelled mirror.

Sunlight gives colours to things. White paper reflects the white light, green grass reflects green light, and a bluebell reflects the blue light.

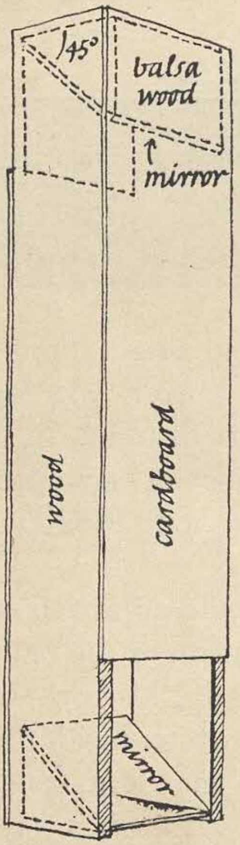
In your Science Notebook

1. Write an account of Experiment Seven, using the headings:

   (*a*) What we did. (*b*) What happened. (*c*) What we proved.

2. Write out as many examples as you can of the uses of different kinds of mirror.

3. Try to find from books some information about periscopes and their uses. Write an account in your notebook.



You can make a periscope from two small mirrors, a block of balsa wood, two strips of wood and two of cardboard. Cut the balsa diagonally to support the mirrors at 45°.

How to train yourself to be a good scientist

First: Are you a good observer?

	marks
1. Close your eyes and try to remember how many electric light bulbs or gas mantles there are in your classroom. Count them to see if you were right.	3
2. What was the very first living thing you saw as you left the door of your home this morning? (It may have been a human being, a dog or a cat, for example.) Can you describe it? Give yourself 3 marks if you are satisfied that you deserve them.	3
3. How many left-handed children are there in your class?	2
Close your eyes. How many wear spectacles?	2
4. Close your eyes and think how many buttons you have on your clothes. Count to see if you are right.	2
5. What was the last thing to be rubbed off the blackboard in your classroom?	2
6. Where is the nearest post box to your school?	2
7. Give the exact order in which the lights appear at traffic lights.	4
8. Give the names and addresses of two churches you know. *each*	2

19 marks to 24 marks: *Excellent observer.*
15 marks to 18 marks: *Very good observer.*
12 marks to 14 marks: *Good observer.*
9 marks to 11 marks: *Average observer.*

2 – *How things are made to look*

1 Why is it useful to be able to make things look bigger? Can you think of many examples?

2 What is the name of the instrument which makes things that are far away look bigger? What is the name of the scientist who uses this instrument?

3 What is the name of the instrument which makes small things near to our eyes appear to be bigger?

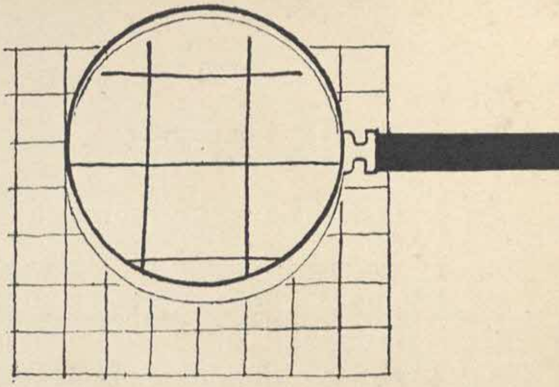
4 What shape are the lenses in spectacles? Do you know what contact lenses are?

Things to do

1 Examine different kinds of old spectacle lenses, stamp lenses, magnifying glasses or other kinds of curved lenses. Feel them and look at them from the side. Are they thin or thick in the middle as compared to the sides? Draw your lenses in side view. Look through your lens at different things. Look at the print on the pages of this book. Do the lenses make the letters smaller, bigger or bent? Look at your finger ends and such things as coins, stamps or flowers, to see things which your eye cannot easily see.

2 Put one drop of water on a clean piece of glass. Look at small print through the drop of water. What do you see? Bend a piece of wire to make a small circle and dip it into water so as to make a lens made of water. Try your water lens.

piece of glass with drop of water



The magnification is FOUR

3 Draw a number of small, equal squares on a blank piece of paper. Look carefully and count how many small squares outside the lens fit into one of the magnified squares under a magnifying glass or lens. In the drawing above, this magnification is four. What is the magnification of your lens? Do all lenses make things look bigger?

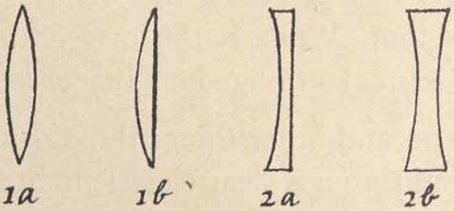
4 Look at your hand and other things through the bottom of glass tumblers and through clear electric light bulbs. Do the same thing with a clear, glass marble and a round bottle filled with water and corked.

5 Try to arrange to look through a microscope. Your teacher may be able to borrow one from a Secondary school and fix it up for you to look at the exciting new world which can be seen. It will be worth going to some trouble to get this first glimpse through a microscope.

6 Hang a match on a length of cotton inside a bottle. Use a lens on a bright, sunny day to try to set the match alight. What kind of lens do you need to use? Try Experiment 1 from Book One, page 90, again.

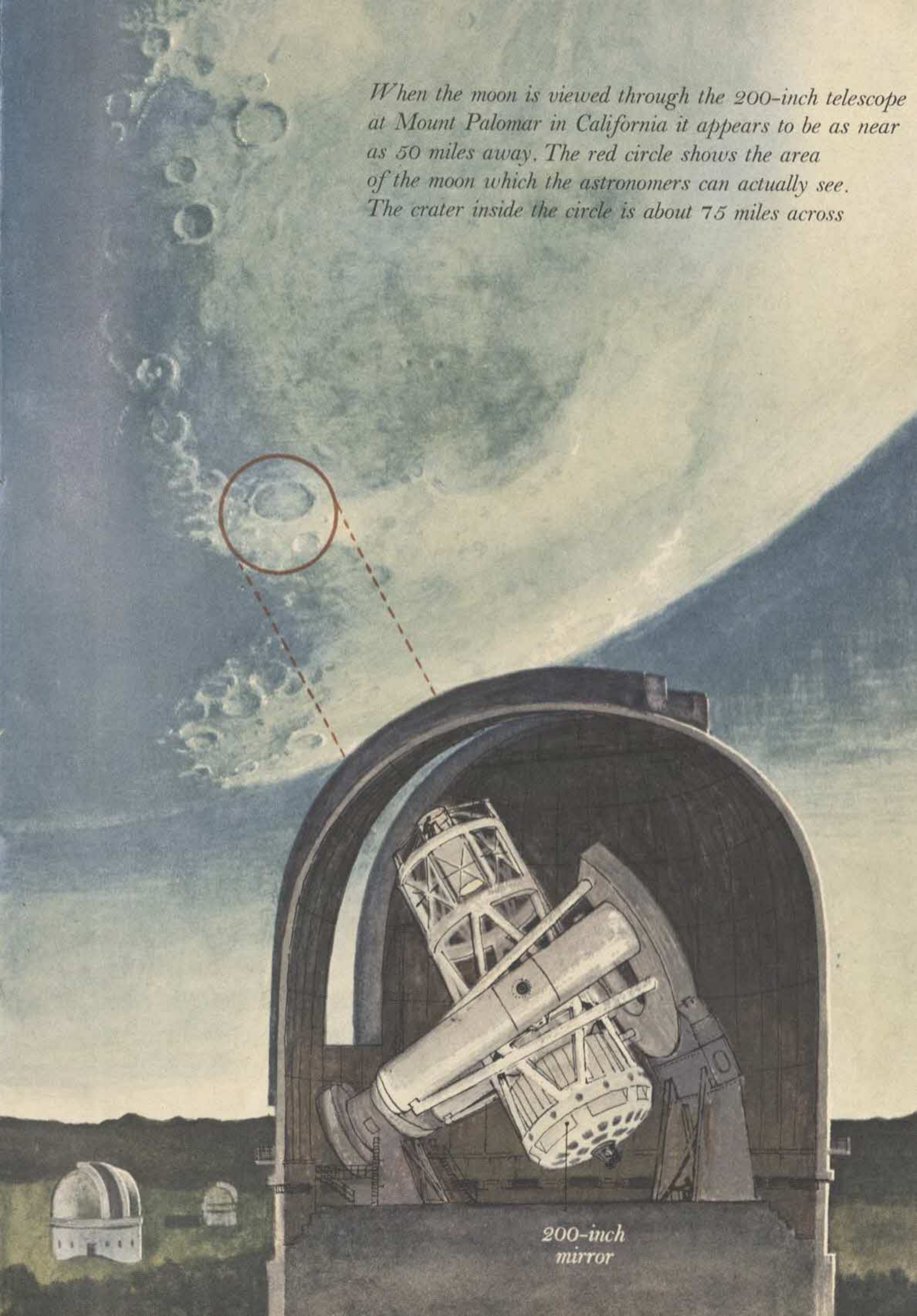
Things to remember

Looking at things through good-quality plain glass does not make them look different. Glass lenses do: 1a and 1b make things look bigger; 2a and 2b make them look smaller. Both kinds of lens are used in different kinds of instruments. In the microscope, several lenses are used so that the scientist can examine very tiny things, like germs, for example, which cannot be seen with the eye alone. The telescope is used by astronomers and appears to bring the stars and planets nearer for a closer examination than can be made by the eye alone.



In your Science Notebook

1. Find a picture and account of a microscope. Make an interesting page of drawings and notes showing some of the things you have been able to discover.
2. Try to find a newspaper which gives a diagram of the night sky this month. Compare it with what you see in the sky on a clear night, and make your own diagram of the stars you have been able to recognise.
3. Look up the meaning of *transparent*, *translucent* and *opaque* in your dictionary. Make columns in your notebook and write lists of materials which can be put under these headings.



When the moon is viewed through the 200-inch telescope at Mount Palomar in California it appears to be as near as 50 miles away. The red circle shows the area of the moon which the astronomers can actually see. The crater inside the circle is about 75 miles across

3 – *How we see*

1 Why are you unable to see anything in a dark room?

2 Can you think of any difficulties we would have if we had only one eye?

3 Why do people wear spectacles?

4 How is your eye protected from knocks and from dust?

5 Can you see under water? If you do not know, how could you find out?

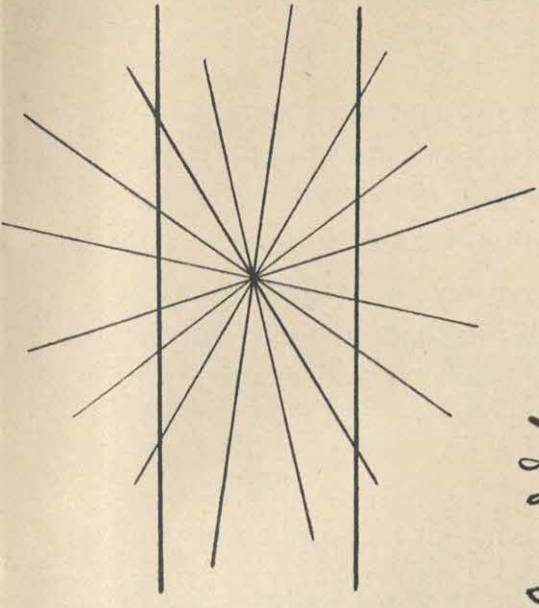
6 What do long-distance swimmers do before setting out on their long swim? How do they protect their eyes? Why is it necessary?

7 Why do animals have such varied colouring? Which animal can change its colour to match its surroundings?

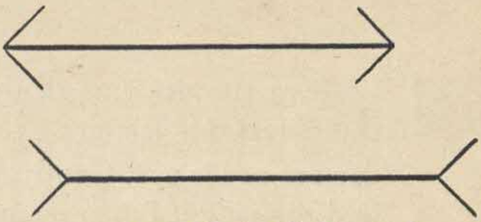
Things to do

1 Hold out your index finger upright at full arm's length in front of your eyes and level with your nose. Look at something behind it which appears to be on the top of your finger and close one eye. Now open your eye and close the other. What happens?

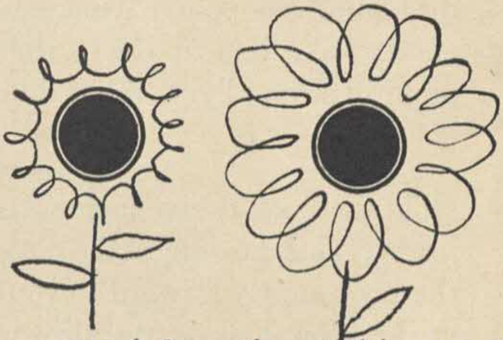
2 Hold a fountain pen without its top at arm's length from your nose. Now close one eye. With your eye closed, try to put the top on. Try the same experiment with your other eye closed. Finally try with both eyes open. Which is the easiest way?



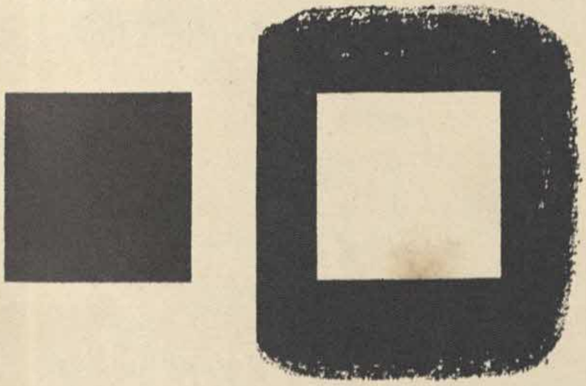
Which lines are curved?



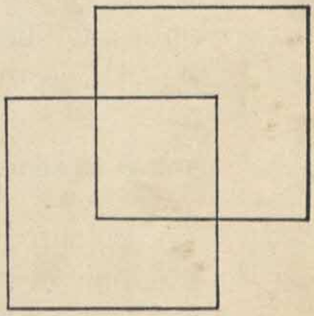
Which line is longer?



Which flower has the bigger centre?



Which square is larger?



Which square is nearer?

3 Let us try to prove that things may be made to appear different from what they really are. Which of these lines is the longer? Measure them with a ruler. Which of these squares is the bigger? Use your ruler again. Do you know of any other optical tricks?

4 Look at the drawing of the eye on page 23. Examine and compare your friend's eye and try to name the parts you can see of his eye. Gently feel your own eye to feel its shape and the way it fits in its protecting socket.

5 Look at the pupil in your friend's eye in a shaded part of the room. Ask your partner also to shade the eye with his hand. Take him across to the windows and examine the pupil in strong light. What difference do you see?

● ✚

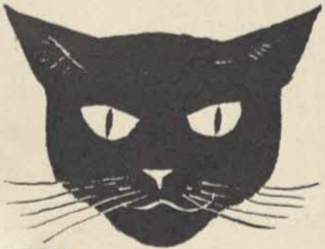
6 Hold the book twelve inches from your face and cover your left eye. Gaze steadily at the dot with your right eye and move the book slowly forward to your face. What happens to the cross? Now look at the drawing of the eye on page 23. Where the optic nerves leave the eye to go to the brain, there is a 'blind spot' in that part of the eye. When its image is on this spot, the cross seems to disappear.

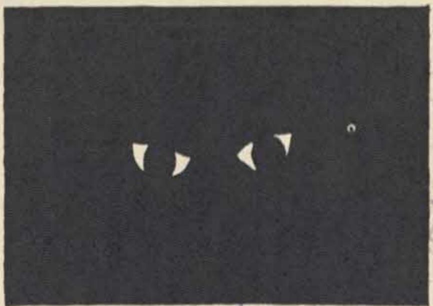
Things to remember

The coloured ring of muscle in your eye is called the *iris*. The hole in the middle is the *pupil*. The iris opens in order to allow more light into the eye; this happens, for instance, in poor light. The iris closes to make the amount of light entering the eye less; this happens in very bright light. The lens can be made wider or narrower in the middle by the muscles of the eye. You can therefore see things at some distance away or things near at hand. Things are seen best when they are focused by the lens on to the back of the eye near the middle. If they are focused on the blind spot of one eye and the other is closed, they cannot be seen. Things you see with two eyes have height, depth and width; they are not just flat. Two eyes also help you to judge the distance of things. The length and size of things can be made to appear different by the use of other lines in different positions or by the use of colour. This method was used in wartime to camouflage ships, aeroplanes and buildings. Horizontal lines on football jerseys make you appear broader; vertical lines, taller. Birds and animals are usually camouflaged to help them to hide from their enemies. Good examples are the zebra, frog and lion.

In your Science Notebook

1. Write an answer to each of the questions at the beginning of this topic. What do the drawings below show?
2. Check the colours of the irises of the eyes of the children in your class. Find out the exact colour of your parents' eyes. Do you have the same colour of iris as one of your parents? Make a table to show the results of your investigation.
3. From books about the eye, make drawings (such as those on page 19) which show that appearances are deceptive. Find out from your dictionary the meaning of the words 'optical illusion' and 'camouflage'.





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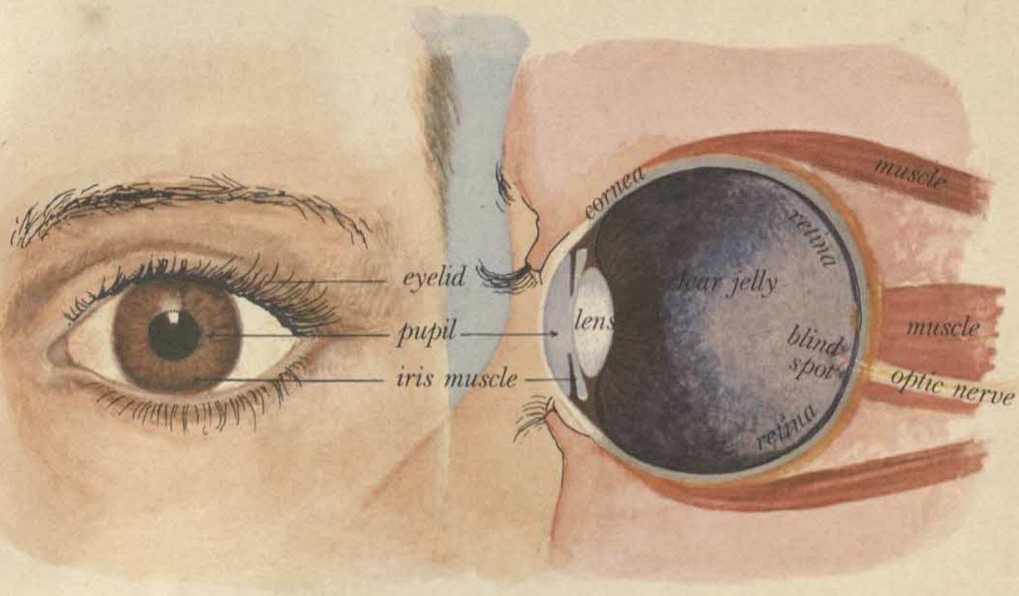
How to train yourself to be a good scientist

Second: Can you measure?

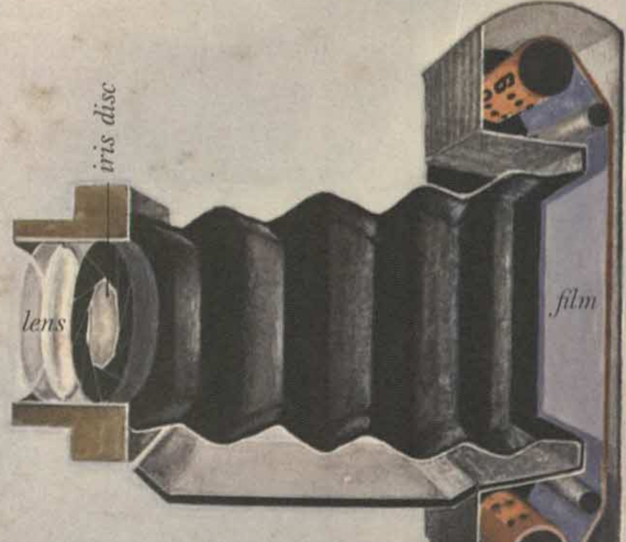
marks

1. Try to guess the length and breadth of a page of this book. Check your estimate. 2
2. Estimate the length, breadth and height of the room you are now in. Check your results. 2 marks for each, altogether: 6
3. What is the distance around your neck? How is it best measured? First guess and then check. 2
4. Ask a friend to hold a watch for you while you estimate the beginning and end of one minute. 2
5. How many glass marbles will fit into a one-pound jam jar so that a cover fits on? 6 marks for a guess within six. If you are just outside six, can you suggest how to award lesser marks? 6
6. How many pints of water does a normal household bucket hold? First look at the bucket. Guess, then check. 6 marks if within a pint. 6
7. Guess the weight of an empty pint milk bottle. Fill it with water and guess again. Check both guesses by weighing. How much does a pint of water weigh approximately? 2 marks empty, 2 marks full and 2 marks for weight of water 6
8. Try to find out a simple way of measuring the height of your school or of a telegraph pole. A Boy Scout can help you. Go out and measure such a pole. Ask an adult to check. 4

More than 24: *Excellent measurer.* 18 to 24: *Very good measurer.* 10 to 17: *Good measurer.* 8 to 9: *Average measurer.*



Inside your eye – and inside a camera



4 – *How your town gets its water supply*

1 How is water made to come into your house and flow out of the tap?

2 What is a water main? A reservoir? A dam? A water tower?

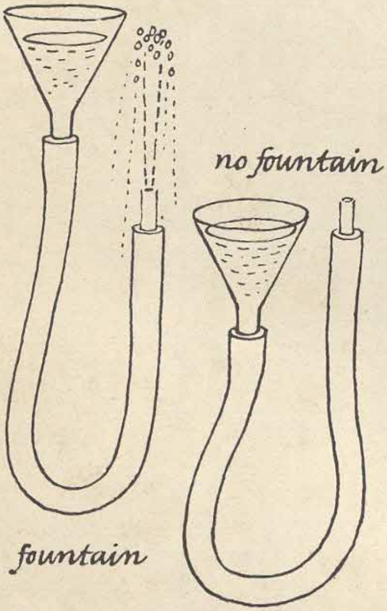
3 Where does your town or county water supply come from? Is any pumped from a deep well?

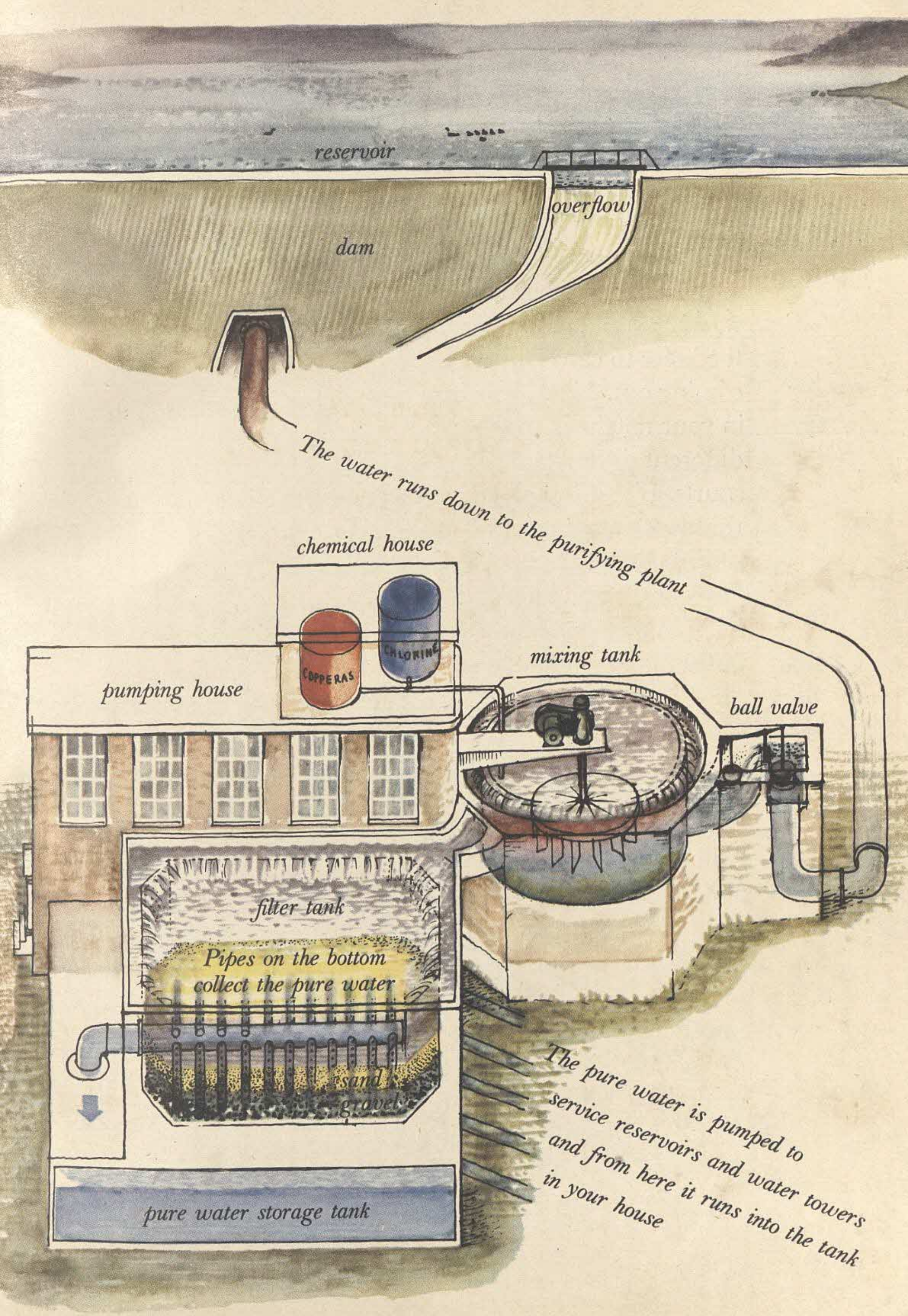
4 Is your water supply purified before you get it?

5 In how many ways is water used?

Things to do

1 Try to get a piece of glass tubing which has been drawn out to a fine hole. Join a funnel to a length of rubber or polythene tubing and put the glass tube in the other end. Fill the funnel with water and hold over a bucket, making sure that the funnel is held higher than the glass tubing. In what position do you get the biggest fountain? If you cannot get a glass tube, nip the end of the rubber tube with your thumb and forefinger.

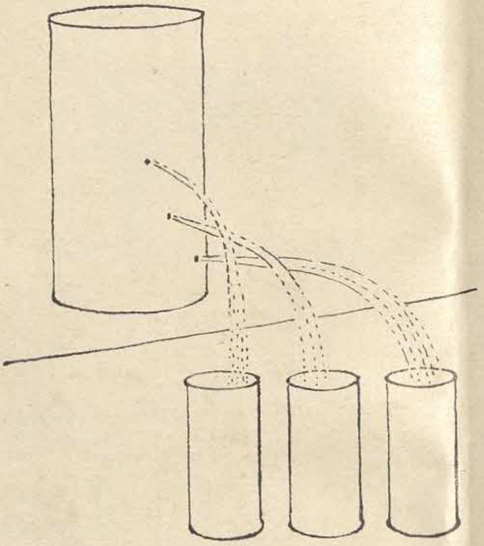




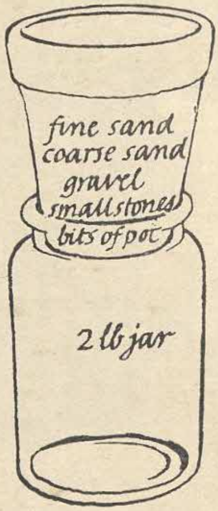
The water runs down to the purifying plant

The pure water is pumped to service reservoirs and water towers and from here it runs into the tank in your house

2 First collect very long tins, the longer the better. Knock three small holes of the same size in the side of one of them with a hammer and a nail, or use a drill. Fill your tin with water and put cans underneath the holes to catch the water coming out. Make drawings in your notebook to show the different distances the water spurts. If you can arrange to do this experiment over a large sink, so much the better! Use another tin and knock three holes in it, all one inch from the bottom. How does the water flow this time?



3 Put some pieces of broken plant pot at the bottom of a plant pot. Add stones, gravel, coarse sand and fine sand. Hold a jam jar underneath and pour muddy water into the top of the plant pot and allow it to drain through into the jam jar. Is the water clearer? (N.B. It is not yet pure enough to drink.) Compare your experiment with page 25.



Things to remember

Water for those who live in a town comes from rain which fills up wells, streams, rivers and reservoirs. This water is pumped by machinery to large tanks which are placed in high places to give pressure. The higher the water can be stored, the greater the pressure when it is allowed to flow into the mains and through the tap.

Water is purified by filtering it through filter beds. Scientists have discovered ways of killing germs and sometimes, if the water is very hard, it is softened before being sent out. Boiling sometimes makes water soft, and the substances which make water hard are left on the inside of your kettle. Boiling will often kill the germs in water. Hard water is water which does not easily give a lather when you wash your hands with soap and water.

In your Science Notebook

1. Write an account of Experiments 1, 2 and 3 in your notebook and draw sketches to illustrate your accounts.
2. Turn back to the questions at the beginning of this topic and, from the answers, write an account of the way in which water is supplied to your home.
3. Householders and other users of water have to pay for it. Find out how much water costs you in your home, and ask your parents to tell you how the bill for water is paid and who receives the money.
4. Find out the meanings of reservoir, dam, hard water, soft water and settling tank. Make notes in your book.

5 – How an aeroplane flies

1 In what way is the flight of an aeroplane like or unlike the flight of a bird?

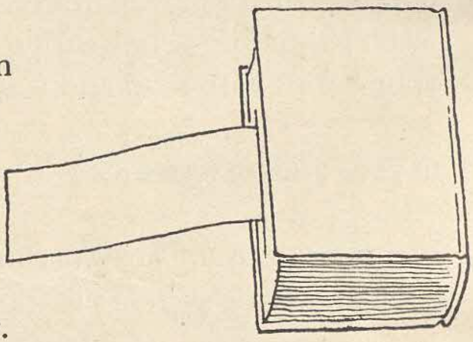
2 How many different kinds of aeroplane do you know?

3 How does the pilot steer an aeroplane? How does he find out where he is, in what direction he is flying and at what height his aeroplane is?

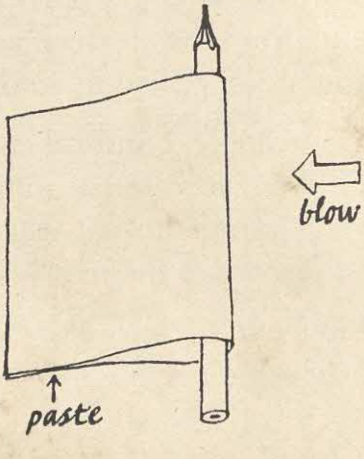
4 How many different parts of an aeroplane can you name?

Things to do

1 Cut a strip of paper 6 inches long and 2 inches wide. Fasten one end between the pages of a heavy book. Move the book through the air and notice what happens to the paper. Can you explain this? Blow hard over the top of the paper. What happens to the paper? Is this what you expected?

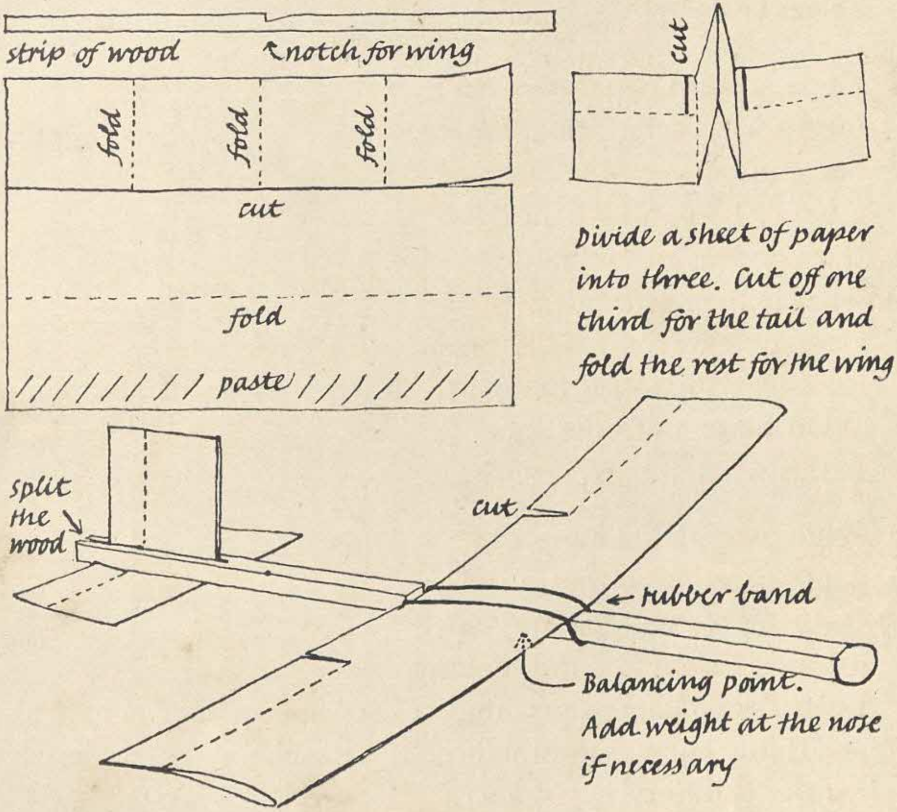


2 Paste two sides of a piece of paper together so that it is like the wing of an aeroplane. Stick a pencil through it and, holding it with your finger tip at the end, blow hard across the wing.



3 Blow up a long balloon and then let it drop from your hand so that the air is released. Your balloon has acted in the way a jet plane moves. If you make a light aeroplane or a car and tie a balloon on to it, you can repeat this test.

4 Here are some drawings to help you to make a model glider. Try altering the angles of the ailerons, tailplane and rudder when you experiment. There are many model aeroplane kits you can buy in the shops. Try to arrange to see a demonstration of one of these models flying. Is there a model aeroplane club in your district?



Divide a sheet of paper into three. Cut off one third for the tail and fold the rest for the wing

Balancing point. Add weight at the nose if necessary

Things to remember

All your experiments show that if air moves quickly the air pressure becomes less. Whatever you are blowing over is therefore lifted because the air pressure underneath is greater. This is what happens to the wing of an aeroplane or a glider. Each wing is tilted upward at the front. The tilt allows the wind to press on the under part. The air rushing over the top makes the pressure less and the wing is given lift.

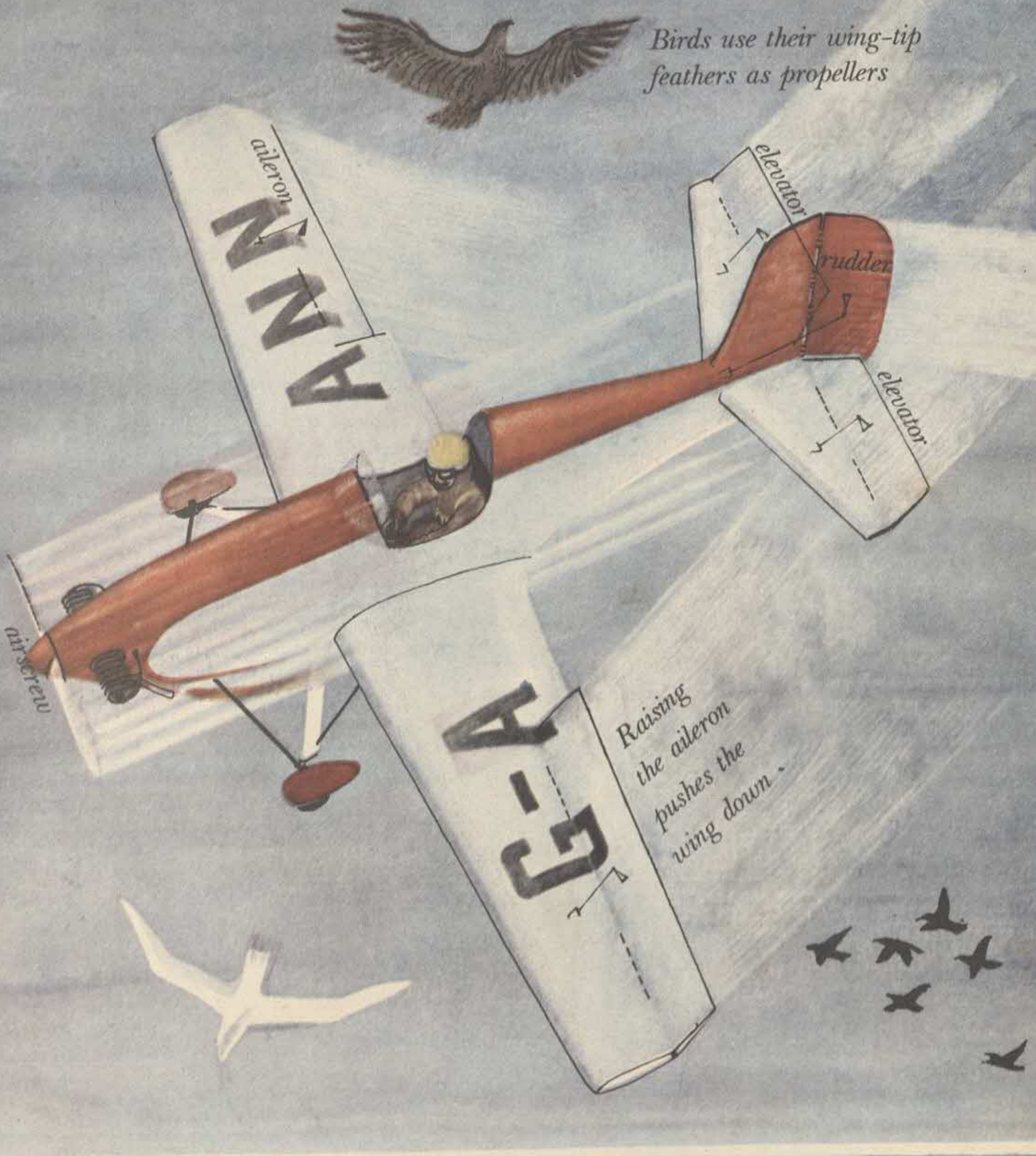
The aeroplane is kept steady by its rudder, climbs and dives by the elevators on its tail and can be made to bank by raising or lowering the ailerons on the wings. Aeroplanes are streamlined (shaped like a fish, for example) to lessen the resistance of the air.

In your Science Notebook

1. Make drawings of an aeroplane and a bird and say in what ways their flight is similar or different.
2. Collect pictures and models of different types of aeroplane and arrange an exhibition.
3. Write down the names of as many different parts of an aeroplane as you can.

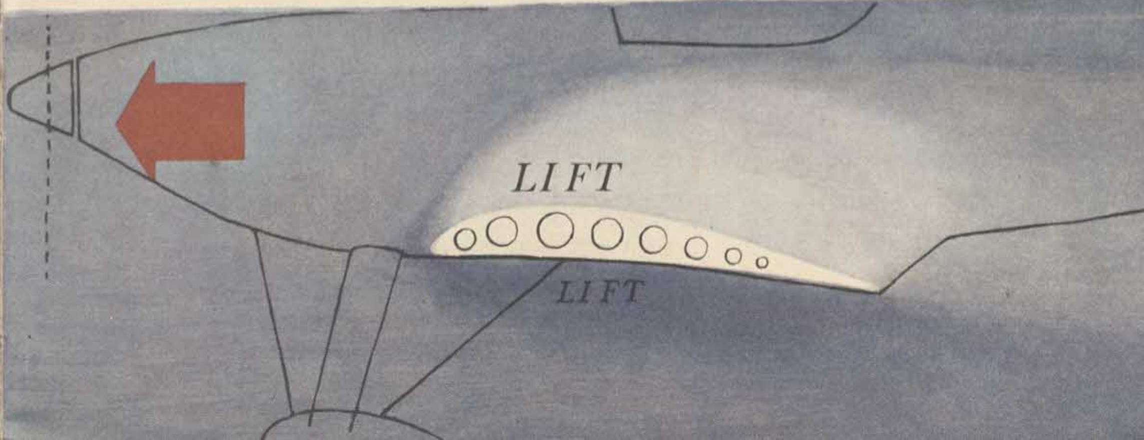
How much does the air press?

Air presses nearly 15 pounds on every square inch. This means that there is a total force of 5 tons on an open, double sheet of ordinary newspaper.



Birds use their wing-tip feathers as propellers

Raising the aileron pushes the wing down.



6 – *Machines: How to move things*

1 What are the most useful tools you have in your home?

2 What machines are used to move or lift heavy weights?

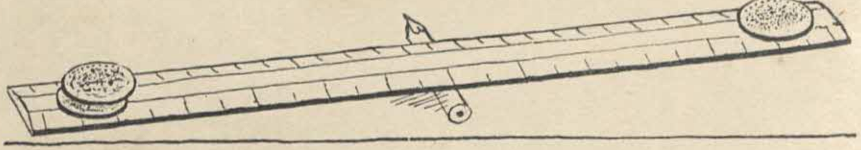
3 How is a very heavy barrel loaded on to a lorry?

4 How many different ways can you think of in which wheels are used? For example, in factories, in gardens, for transport, by children and so on.

5 How many tools do you know with which you can exert a much greater force than usual?

Things to do

1 Balance a long ruler and put a weight, such as a penny, on one end. Put another penny on the other end. When do they balance? Move one of the pennies but do not move the other. What happens? When will one penny balance two pennies?



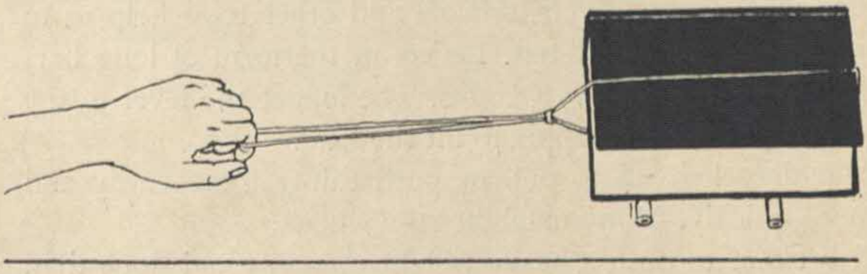
2 Open a door wide. Press with one finger near the hinged side. Can you push the door? Move your finger nearer the handle side and push again. Is it easier or harder to close the door? Try pushing with your finger in different spots at the same height from the floor. Is it easier to close the door by pushing nearer to, or farther from, the door handle?

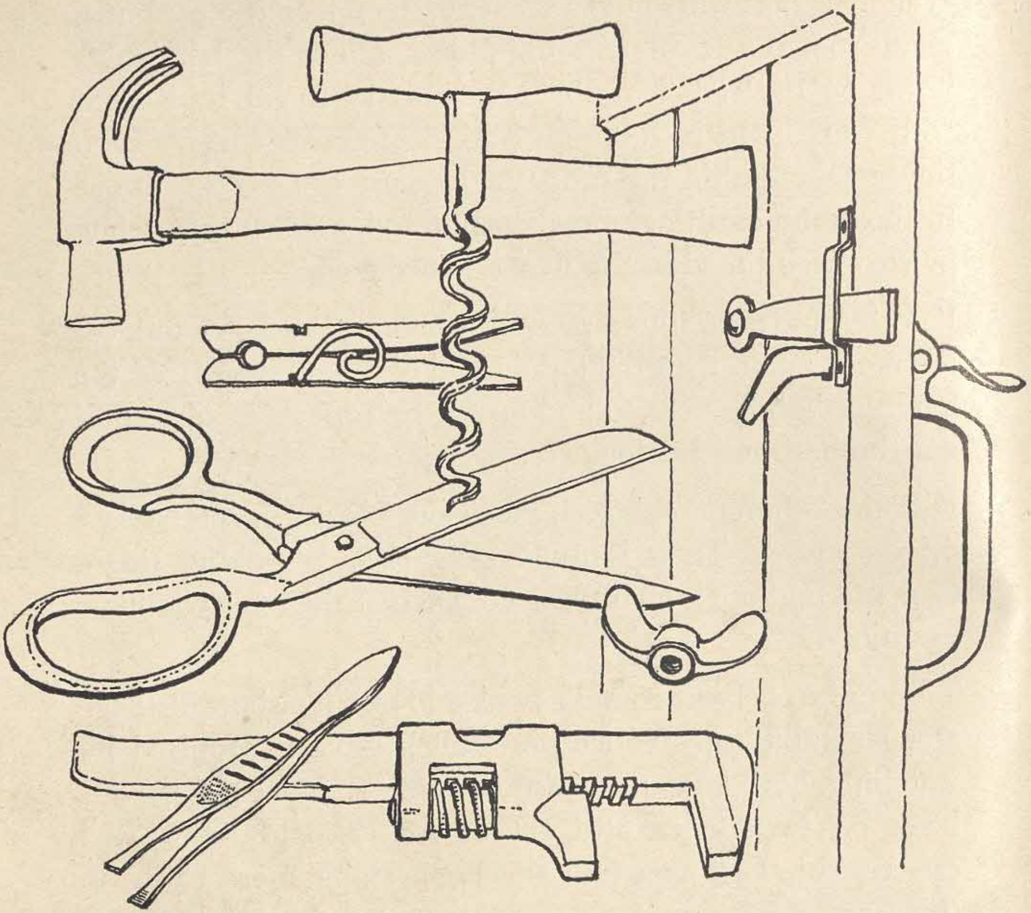
3 Weight a box with pieces of heavy metal or stones. Put a metal rod, resting on a round object, under the box. Press down on the rod near the box and try to lift it. Repeat with your hand in different positions, getting nearer each time to the end of the rod. Where must you press to move the box most easily? A metal curtain rod, a poker or a strong piece of wood used in this way is called a *lever*.

4 Knock some nails into a piece of wood and then try to lever them out again with the forked end of a hammer. Hold the hammer handle near to and far away from its head to find out the best position for exerting your strength.

5 Examine different tools such as scissors, pliers, pincers, screwdrivers, chisels. There is usually a best way of holding them. Can you find out which this is for each of the tools you have examined?

6 Tie a piece of elastic round a book and pull it a short distance along a table top. Notice how much force is required by watching how long the elastic stretches. Now place your book on two pencils (to act as rollers) and repeat the experiment. Can you pull the book along more easily in this way?





Things to remember

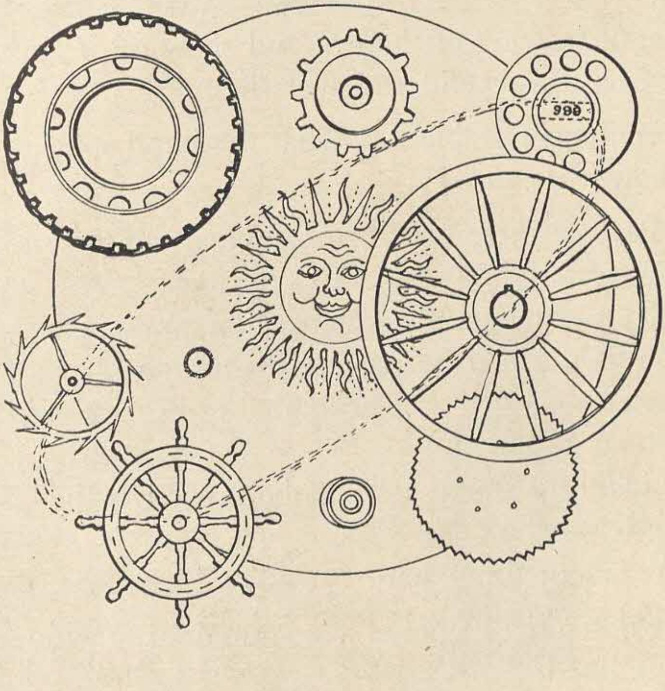
Hammers, screwdrivers, scissors and other tools help us to move, turn or cut things. Levers in the form of long bars enable us to lift heavy weights. The longer the lever is, the less weight need we apply to lift the load.
Machines help us to pull or push things more easily and more quickly. Many machines use wheels.
It is easier to push a heavy weight up a gradual slope than up a steep one.

In your Science Notebook

1. Draw sketches, using the pictures on these pages, to show the following ways in which work is made easier: (*a*) by using wheels, (*b*) by using rollers.

2. Look up the meaning of the word 'ramp' in your dictionary. Write down the meaning in your notebook. Draw examples of the uses of ramps, e.g. unloading heavy boxes from a lorry; a workman using a wheelbarrow and a plank; a parcel chute at the G.P.O.

3. Can you draw the following being used as levers: (*a*) a spade; (*b*) a doorlatch; (*c*) a crowbar; (*d*) your arm?



1. Complete the following sentences:

a) A reflection in a mirror is called an ———.

b) The colours of the rainbow, in order, are ———, ———, ———, ———, ———, ——— and ———.

c) A red apple in a dark room appears to have ——— colour.

d) Light from the sun travels in ——— lines.

e) A rainbow is formed when light from the sun passes through ———.

2. microscope periscope telescope

Write three sentences using one of these words in each to show that you know the difference between them.

3. Make a drawing of the eye and show on it: pupil, iris, cornea, eyebrow, eyelid and eyelashes.

4. As briefly as possible, say what the blind spot in the eye is and how it is caused.

5. Use each of these words to complete the sentences:

reservoir tower pressure soft filter

a) A town's water supply is sometimes stored in a ———.

b) Water is purified by passing it through ——— beds.

c) A water ——— is placed in the highest part of the town.

d) The higher water is stored, the greater is the ——— from the bottom.

e) Water is sometimes made ——— by boiling.

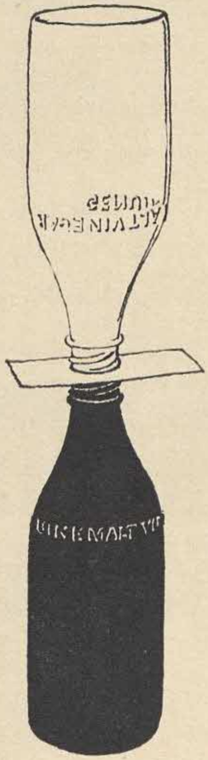
6. Write down the names of five animals or machines which are streamlined.

7 – *How your home and school are heated*

1. How many different ways are used to heat houses?
2. Is your school heated in the same way as your home?
3. What does 'fuel' mean? How many different kinds of fuel do you know?
4. Why is a coal fire not always the best way to heat a room?
5. What does your father do to stop cold air getting into your house in winter? What does 'lagging the pipes' mean? Why is it done?
6. How does your body lose heat?

Things to do

1. Put a little ink in a large bottle and fill up with fairly hot water. (A bottle will not stand boiling water.) Fill another similar bottle with cold water and slide a piece of cardboard over the mouth. Now upturn this bottle exactly over your first bottle and slide the cardboard away. Watch carefully and try to explain what happens.



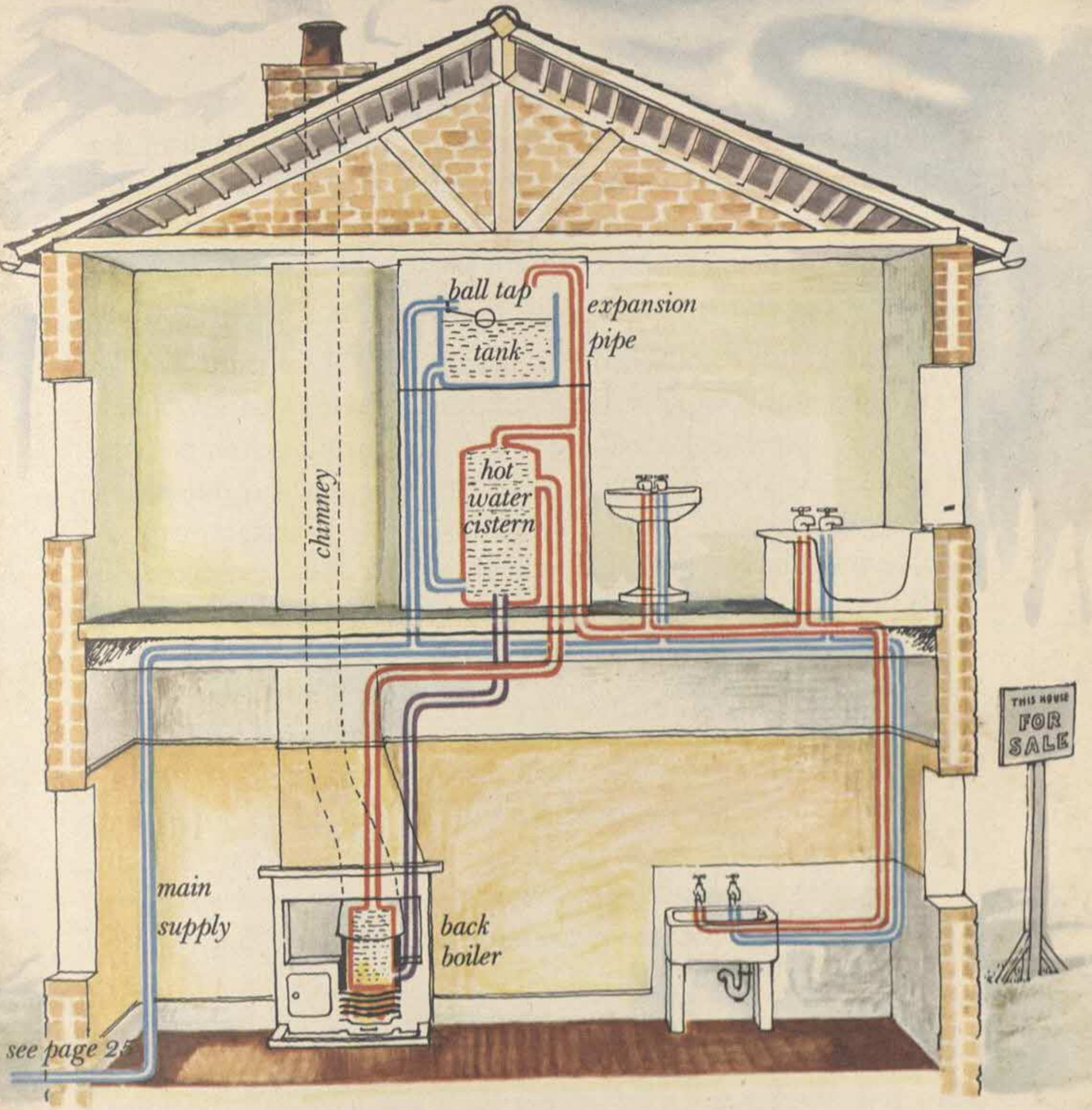
2 Get two tins and paint the outside of one black and the other white. Fill the tins with water and leave for some time near, but the same distance away from, a hot radiator. Which tin gets hotter?

3 In wintertime, put strips of differently coloured cloths on untouched snow when the sun is shining. Lay them side by side beginning with black and ending with white. After a while, examine them to see which has sunk deepest into the snow as the sun warms them and melts the snow beneath. In summertime, cover thermometers with differently coloured pieces of cloth and hold them the same distance from an electric fire. Read the thermometers. Can you give a reason for the difference?

4 See if you can reflect heat from the fire with a mirror. Can you invent ways of proving that you have succeeded in reflecting heat? Do you know where reflectors of heat are used?

5 Examine the hot-water system in your home or school. Find the hot-water cylinder and feel it when it is hot, warm and cold. As far as you can, follow the course of the hot water as it travels round the building in the pipes. Where does the cold water come from to replace the water lost? What sort of fuel is used in your school boilers? Ask the school caretaker how much fuel he needs to use.

6 Damp your forehead with water or eau-de-Cologne. Does your skin feel cooler? Do you know why?



Things to remember

In a hot-water system, fuel is burned to heat the water in the boiler. Hot water is pushed up by the cold water which takes its place. This causes a circular movement of water around the system and hot water is thus carried to all parts of the building.

Burning coal on an open fire is most wasteful. Much of the heat goes up the chimney and is lost. Smoke, too, goes up and pollutes the air outside. Pipes which may freeze in the winter need to be covered with layers of felt, thick strips of blanket or newspapers.

Dark or dull coloured things get hot quickly since they take in heat more rapidly than brightly coloured things. Dark things, like black earth, get hot in sunshine. White hats, blouses or shirts reflect part of the heat and do not get as warm as darker materials. In winter, we keep warm by wearing darker and thicker clothes. In summer, we wear thin, more loosely fitting clothing. We also take off some of the layers of clothing we wore in winter because the layers of air between the clothing keep in the body's heat.

The human body tries to keep at the same temperature at all times. Your blood loses heat when it comes to the skin's surface and thus the temperature of the body is regulated. If the weather is cold, the body sends less blood to the surface to lose heat. When you are very hot, beads of sweat form and when these evaporate, they use the body's heat and so make you cooler.

In your Science Notebook

1. Write accounts of Experiments 1, 2 and 3 in your notebook and draw sketches to illustrate the accounts.
2. Draw or collect pictures of people of various countries to show the different clothing worn in each. Write notes under the pictures to show why the clothing suits the climate.
3. Write an account of how your school is heated in winter.

8 – *How your electric torch works*

1 How many times can you think of when a torch is a very useful thing to have?

2 How many different shapes of torch have you seen?

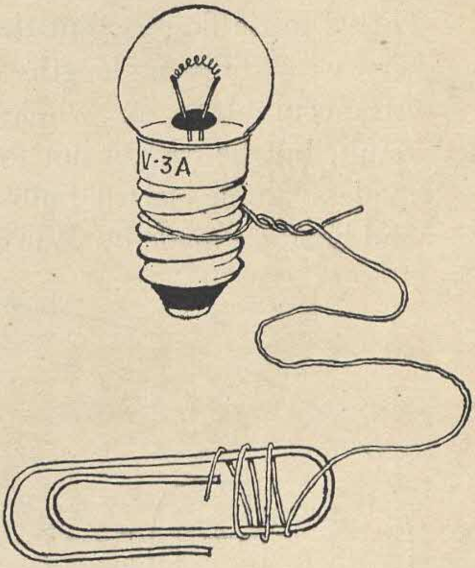
3 Why do torches sometimes have thick lenses and bright reflectors behind the bulb?

4 Does the bulb of an electric light or a torch get warm? Is this a good thing?

5 Have you ever seen a car battery accumulator? What is it like?

Things to do

1 Examine the small bulb from your torch or bicycle lamp. Try to find the two 'lead-in' wires. Inside the bulb these wires are joined together by a piece of very fine wire. Can you see it? Take an old electric bulb which will not light. Is the fine wire broken? If it is, the circuit is broken. Can electricity pass through?



REMEMBER UNDER NO CIRCUMSTANCES MUST YOU USE THE ELECTRICITY FROM THE MAINS. IT IS DANGEROUS

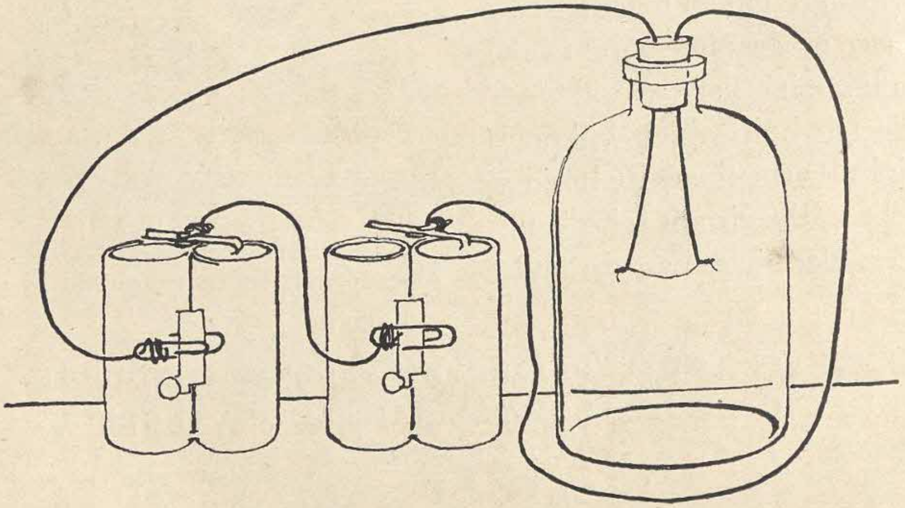
2 Take the various pieces of your torch apart and learn the names of the parts.

Wrap a piece of thin copper wire round the terminal of a battery (or use a paper clip).

Join the other end of the wire to the metal screw part of the bulb. Join another piece of wire to the other terminal and touch the solder part of the bulb.

You have now made an electric circuit. There is a complete path joining the bulb to the terminals of the battery. Try a piece of string or a pencil in the circuit. Do you get a light? How is the circuit made in a torch?

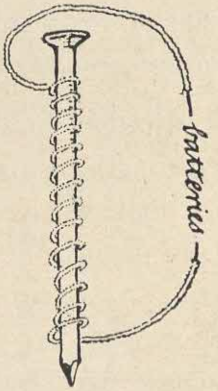
3 Join the terminals of two batteries to two pieces of thin copper wire. Bend both ends at right angles and join them together with a small length of very thin wire as used by florists to tie flowers. Put them through a cork in a bottle. Try with different lengths of wire until you get a glow. An accumulator or wireless battery will give a better result, but be careful not to burn yourself. You have now made a simple electric bulb or electric fire, since both light and heat are made by your glowing wire.



4 Use the same apparatus as above, but instead of the iron wire, use very thin strips of the silver foil in which food or chocolates are wrapped. Different kinds of metal are used by manufacturers for foil so you must experiment to find the right kind. Feel the foil to see if it gets warm. If you choose the right kind, it will even get hot enough to melt.

5 Ask your teacher or another adult to break off the metal part of an old electric bulb so that you can see each part separately. Do you understand what each part is for?

6 Wrap many coils of insulated copper wire around a two-inch nail. Pass an electric current from two batteries through the wire. Prove that the nail becomes a magnet. Switch off your supply of electricity. Is there any change? Use the magnet to attract a small pile of iron filings or a nail.



Things to remember

An electric battery is a storehouse of electricity. Like any storehouse, it can become empty. Electricity will pass through copper wires but not through string, wood or paper.

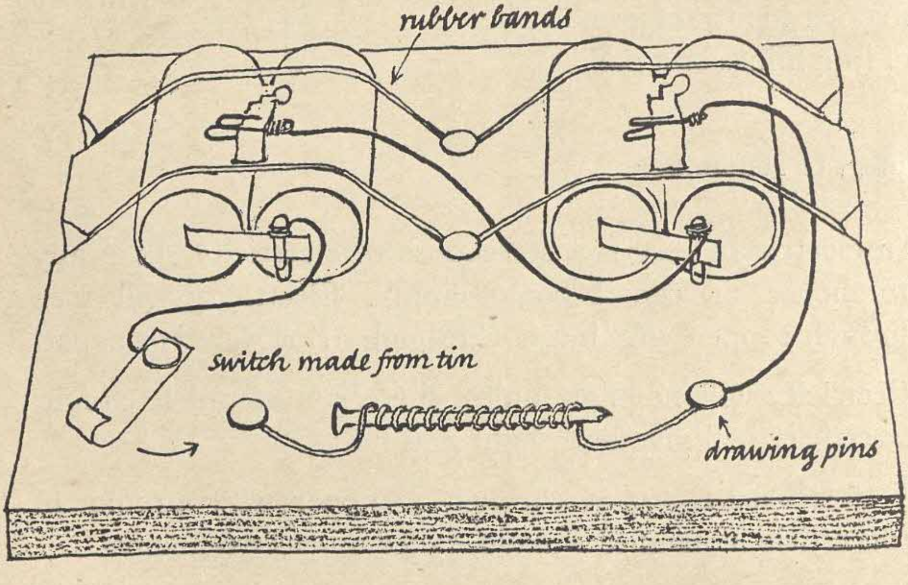
Electricity will not flow unless there is a complete circuit. Electricity will give both light and heat.

If electricity is passed through a copper wire around an iron article, a magnet is made, called an electro-magnet.

Electricity is extremely dangerous. You can receive a severe shock or burn from the electricity in an accumulator and under no circumstances should you tamper with electric wires or switches in your home or school.

In your Science Notebook

1. Write an account of Experiments 2, 3 and 6 with drawings to illustrate them.
2. Try to find out from books and other sources as many different ways as you can in which electricity is used in the home and outside.
3. Try to find out in how many different pieces of equipment an electro-magnet is used. If you have an electric alarm bell in your school, ask your teacher to show you the magnet inside it.



Did you know that . . . ?

Elephants do not drink through their trunks, but squirt water into their mouths from their trunks.

Camels can go without water for as much as 10 days and in rare cases even longer.

High jump

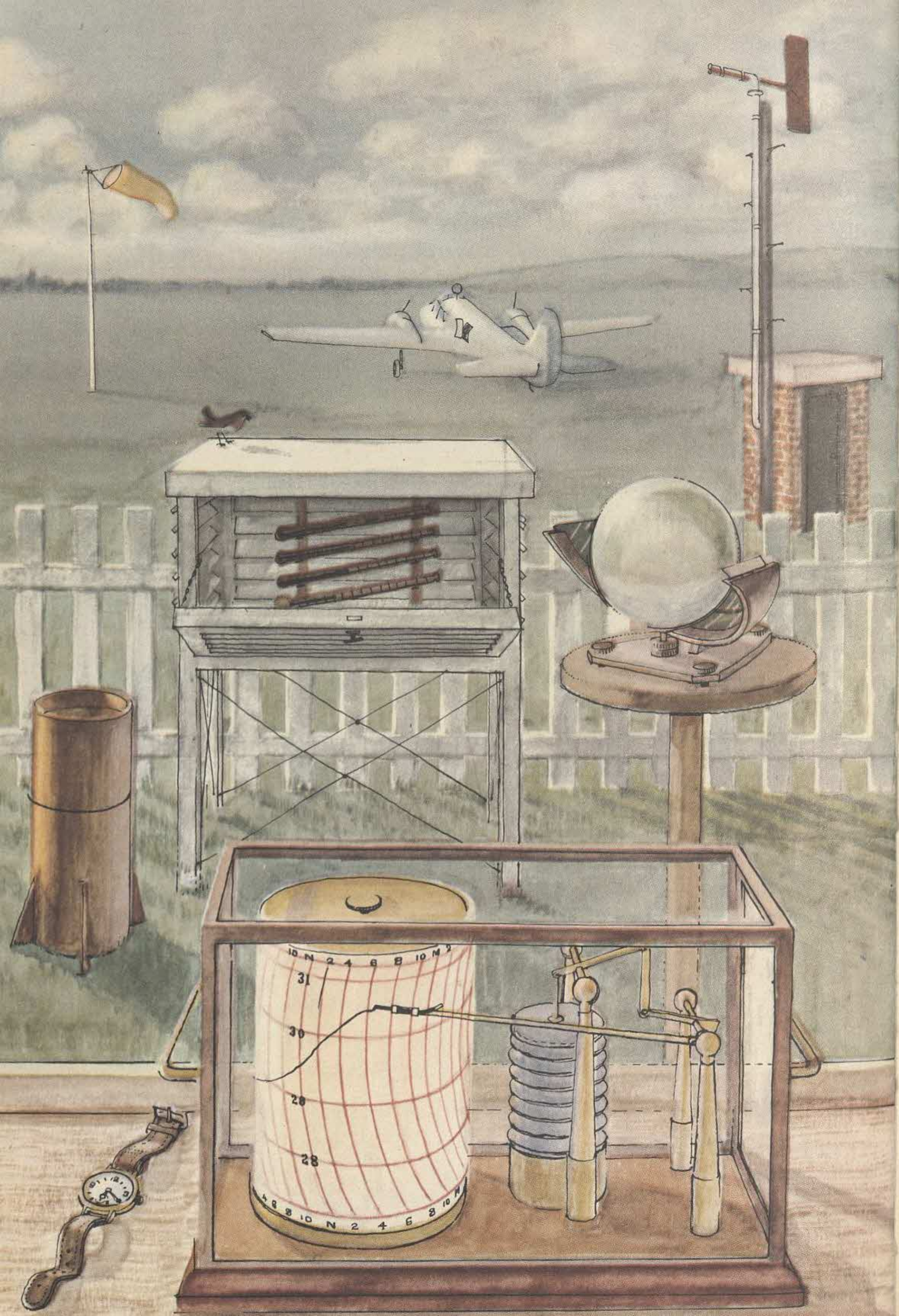
A man weighing 180 pounds on the earth would weigh 4,000 pounds on the sun, but only 30 pounds on the moon. He could jump 36 feet high on the moon.

How fast does sound travel?

In air, 1,090 feet per second; in water, 4,700 feet per second; in brick, 12,000 feet per second; in iron, 16,800 feet per second. In other words a sound travels 1 mile in 5 seconds in air and about 1 mile in 1 second through water. Light travels 186,000 miles per second.

How do wild animals prepare for winter?

Some birds leave our shores (migrate)—for example, swallows.
Some animals go to sleep (hibernate)—frogs and flies.
Some grow longer hair—dogs, sheep and horses.
Some dig deeper into the soil—earthworms.
Some change their state into one of resting—the pupae of butterflies.


10 N 2 4 6 8 10 M 2
31
30
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28
4 6 8 10 N 2 4 6 8 10 M

9 – *How we record the weather*

1 What things around us show how fast the wind is moving?

2 When is it important to know how fast the wind moves?

3 How many ways do you know of finding which way the wind is blowing? Look at the picture opposite.

4 How many different names for winds can you remember?

5 What happens to the water in puddles or on the pavement when it dries up? Where does it go?

6 How can you tell when it is going to rain?

7 What sort of day does Mother like for drying clothes?

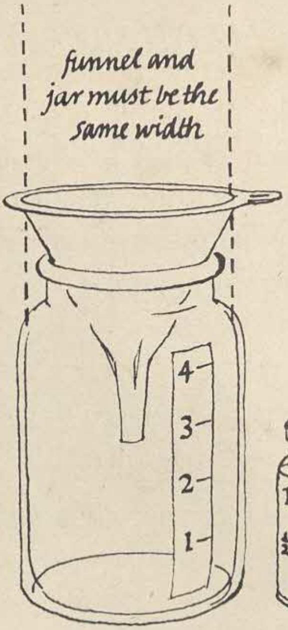
Things to do

1 Find out how the instruments opposite are used to record the weather. Examine some if you can and find out how they are read. Try to visit your town's meteorological station.

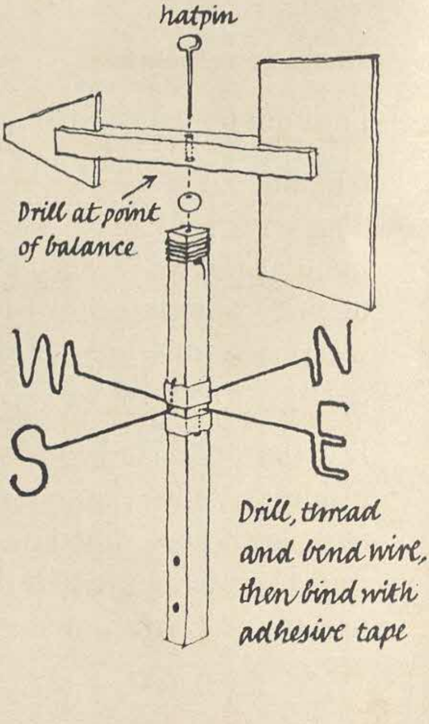
2 Look at the daily weather forecast in your newspaper for a month. Compare it with the radio or television forecast. Keep a record in your diary and note when it is correct, partly correct, or wrong.

3 Breathe on a cold mirror. Look at the glass panes on the inside of your windows on a cold day when the windows have been kept closed and the room is warm. Let a glass of cold tap water stand in the room. Carefully watch the outside of the glass. Can you explain what you have seen?

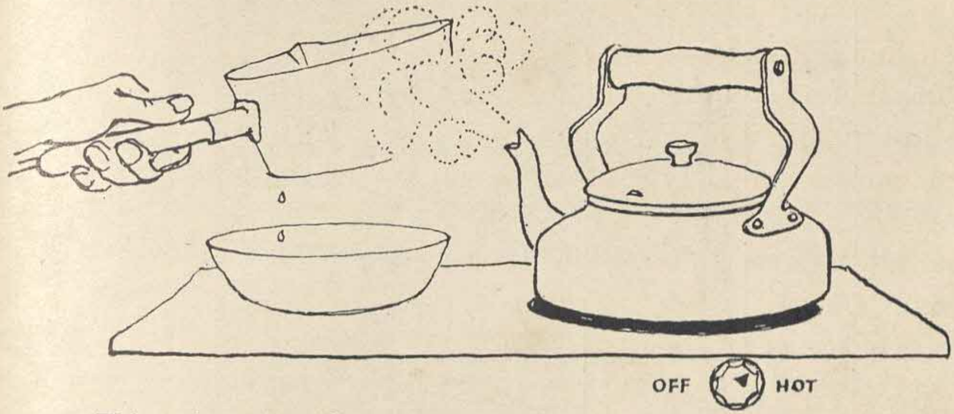
4 Make a rain gauge like the one shown in the drawing. Pour one inch depth of tap water into your gauge. Now pour the water into a very narrow but tall bottle. The height will be much greater than one inch now. Mark the top of the water on your bottle. If you divide this distance from the bottom you will have a simple way of measuring rainfall of less than one inch. Put your gauge outside and keep a record in your notebook of how much rain falls every 24 hours.



5 Cut a wind vane out of wood. Balance it on a ruler to find its point of balance, and bore a hole there to fit a nail or hatpin as in the sketch, so that the vane moves round easily. Now drive the nail in to the end of a 12-inch length of wood. Make direction indicators and nail or glue them to your wood. Can you make a better wind vane than this? Try suitable things like cotton reels, bicycle pedals and other things which move round easily.


hatpin
Drill at point of balance
W
N
S
E
Drill, thread and bend wire, then bind with adhesive tape

6 Ask a grown-up to boil water in a kettle. Notice the little space between the spout of the kettle and the cloud of steam. Hold the flame of a candle near the steam. What do you notice? Put a bright aluminium pan filled with cold water near the cloud of steam and collect the drops of water dripping from the outside of the pan. Keep your hand well away from the steam. Taste the water.



Things to remember

Weather is the state of the air each day in a certain place. Climate is the weather a place has over a number of years. The weather can be hot or cold, clear or cloudy, dry or moist. The wind, the sun, the position of the place you live in and the dampness or dryness of the air, all affect the weather.

Winds are caused by warm air being pushed upwards by cold air. Clouds and mist are really very small drops of water. Water evaporates from puddles, lakes, ponds, wet clothes and from the ground. Water is always present in air but it is usually invisible. When warm air rises, it gets cooler and tiny drops of water condense and collect to make clouds.

Clouds are driven higher when they meet higher ground. When they become still cooler, rain begins to fall. If the air is very cold, the drops of water may turn to hail or snow.

The Beaufort wind scale

	miles per hour		
Force 0	0–1	Calm	*Smoke rises vertically; sea mirror calm.*
Force 1	2–3	Light Air	*Direction shown by smoke drift but not by wind vane; small wavelets.*
Force 2	4–7	Light Breeze	*Wind felt on face; leaves rustle; wind vanes move; short waves.*
Force 3	8–12	Gentle Breeze	*Leaves and twigs in motion; extends a flag; crests begin to break.*
Force 4	13–18	Moderate Breeze	*Raises dust and paper; moves small branches; white horses on the sea waves.*
Force 5	19–24	Fresh Breeze	*Small trees in leaf begin to move.*
Force 6	25–31	Strong Breeze	*Telephone wires whistle; large branches begin to move.*
Force 7	32–38	High Wind	*Whole trees in motion.*
Force 8	39–46	Gale	*Twigs break off.*
Force 9	47–54	Strong Gale	*Slight structural damage; chimney pots fall.*
Force 10	55–63	Whole Gale	*Trees uprooted; considerable structural damage.*
Force 11	64–72	Storm	*Damage widespread; storm (seldom met with in Britain).*
Force 12	73 & over	Hurricane	*Countryside is devastated; usual only in tropical storm; hurricane; waves higher than 45 feet.*

S.A.

In your Science Notebook

1. Use the weather records you have kept of your own district to calculate the average daily rainfall for one month.
2. Collect as many words as you can which refer to weather, e.g. fog, mist, dew. Look up their meanings and put them in your notebooks. (Listen to the weather man on television. He uses many such words.)
3. Try to find out as much as you can about the weather of other countries. Collect pictures and paragraphs from newspapers and magazines and stick them in your notebook.
4. The weather is sometimes responsible for much damage and many accidents. Look out for accounts of these in the newspapers.
5. Find a rainfall map in an atlas and see what is the annual rainfall for your district. Name two places in Great Britain with a heavy rainfall and two places with a light rainfall.

Rainfall

The rainfall in different places in Great Britain is between 20 and 200 inches per year. The average number of days per year with thunderstorms in Britain ranges from 3 (Ilfracombe) to 20 (Wakefield). The greatest number of thunderstorms per year occur in Java, with an average of 322 days per year.

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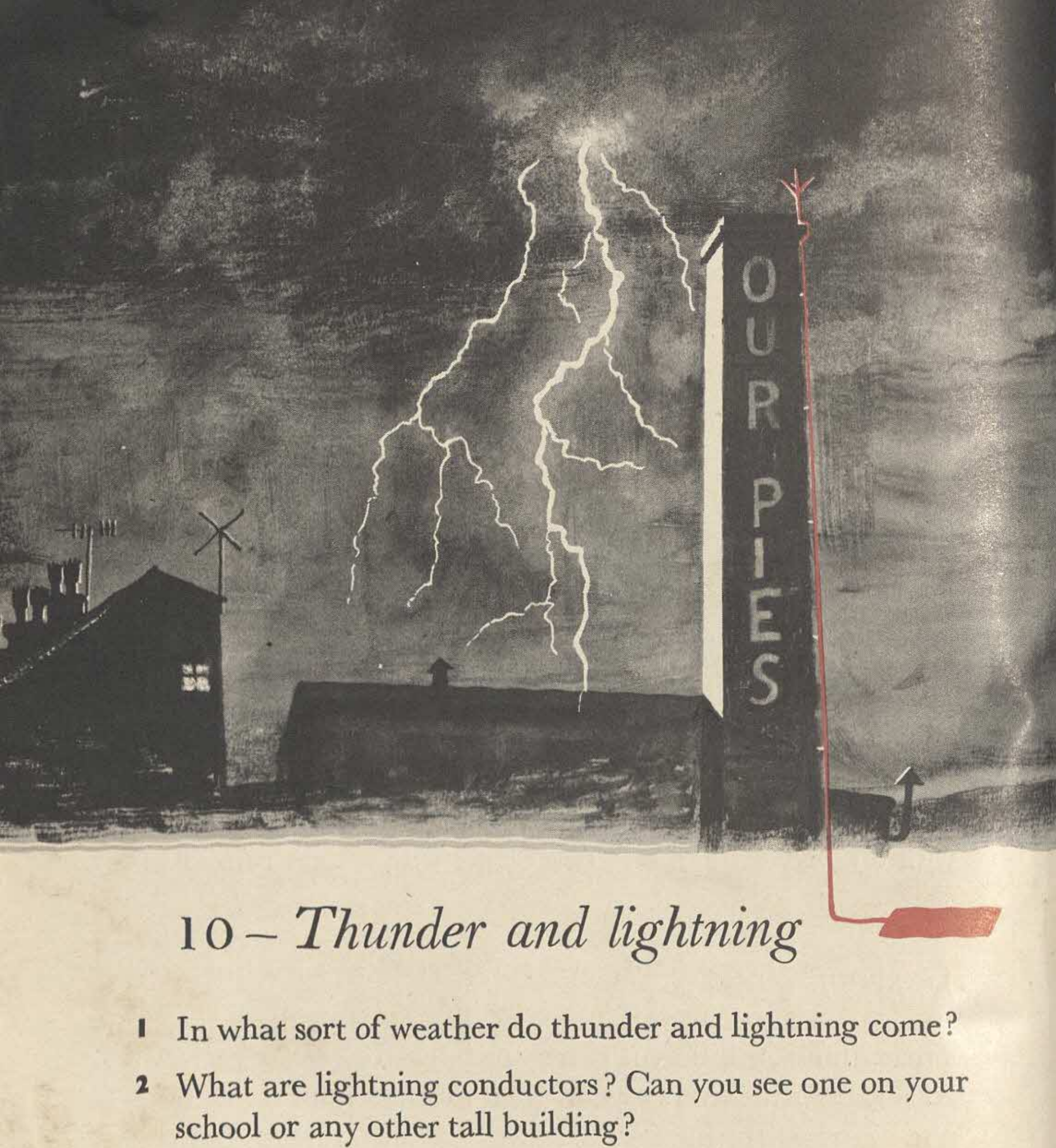
Calcutta



10 – *Thunder and lightning*

1 In what sort of weather do thunder and lightning come?

2 What are lightning conductors? Can you see one on your school or any other tall building?

3 Why should you disconnect your wireless or T.V. aerial if there is a really bad storm?

4 How many different kinds of lightning are there?

5 If you are caught outside in a bad thunderstorm, what do's and dont's should you remember?

Things to do

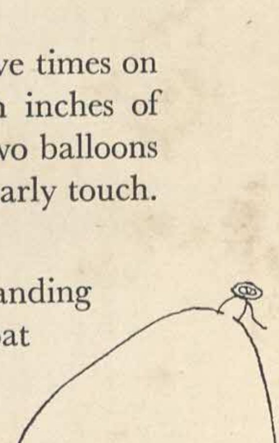
1 Next time there is a thunderstorm, look carefully when the first flash of lightning can be seen and count the seconds between the flash and the thunder. Each five seconds stands for one mile. How far away is your storm?

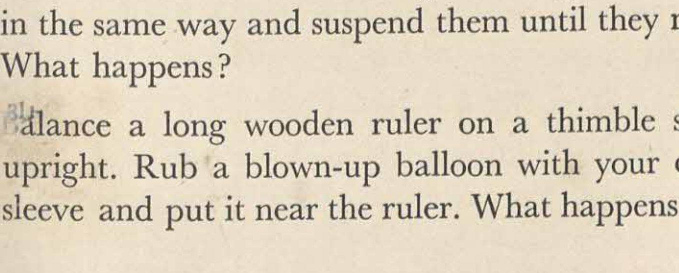
2 Rub a dry fountain pen briskly up and down your coat sleeve, then put it near some tiny pieces of dry tissue paper. Rub a dry piece of sealing wax with silk and do the same. Now try a glass rod, a comb, or a strip of polythene. Bring the rubbed article to your ear. Can you hear anything? If not, try again after you have thoroughly dried everything. A nylon or terylene garment, pulled off in the dark, sometimes gives excellent results. You will not only hear a crackle but be able to see little flashes of light.

3 Put a square of glass on two books and put small pieces of tissue paper in the space underneath. You may like to cut them in the shape of people or animals. Now rub the glass with a piece of flannel or silk. What happens?

4 Blow up a balloon tightly and rub it about twelve times on your coat or cardigan. Suspend it by eighteen inches of cotton and notice how it clings to things. Rub two balloons in the same way and suspend them until they nearly touch. What happens?

5 Balance a long wooden ruler on a thimble standing upright. Rub a blown-up balloon with your coat sleeve and put it near the ruler. What happens?





Things to remember

You have been making electricity by rubbing things. The things rubbed behave differently because they are electrified. This kind of electricity made by rubbing is called frictional or static electricity. The clouds make electricity too, probably by the breaking up of drops of water into still smaller drops as they rise. A flash of lightning is seen when a very big spark passes from one cloud to another, or to a building or a tree. In the second case the electricity is said to have gone to earth. Lightning is followed by thunder. Light travels much more quickly than sound and although the lightning and thunder occur almost together, we do not hear and see them at the same time.

A copper lightning conductor is often put on tall buildings so that the electricity will pass harmlessly to earth instead of causing damage.

You should never shelter under a tree or near a high building during a storm with thunder and lightning. You should also be careful not to touch a wire fence with any part of your body.

Correction!

It is said that lightning never strikes twice in the same place. The Empire State Building in New York was struck 68 times by lightning in the first ten years after its erection.

In your Science Notebook

1. Write accounts of Experiments 2, 3, 4 and 5, and make drawings to illustrate your accounts.
2. Your newspaper often carries pictures and accounts of the effect of lightning. Try to collect some for your notebook. In addition, collect pictures or make your own drawings of lightning.
3. Find out who Benjamin Franklin was, and write an account of his experiments with a kite and his invention of a lightning conductor.

How to train yourself to be a good scientist

Third: How good are you at experiments?

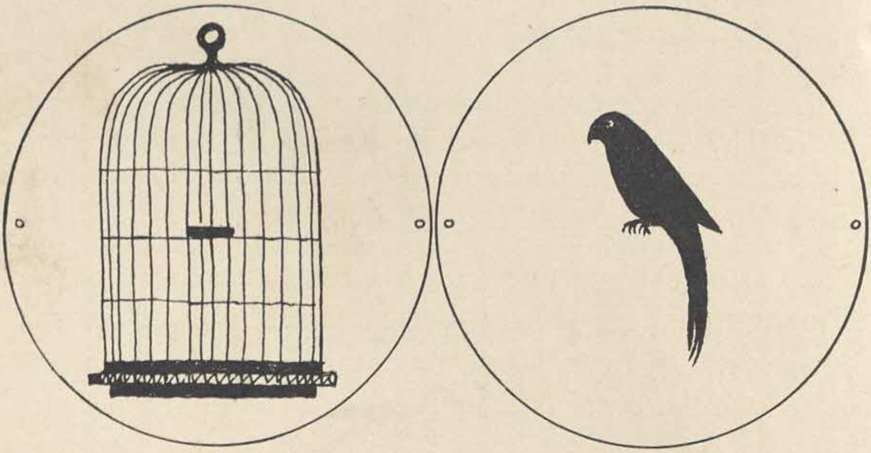
1. Find out on which side a matchbox must be placed to be most stable.
2. Draw a square of one and a half inch side. Divide it into smaller squares of half inch side. How many squares can you count in your drawing?
3. Five new halfpennies weigh one ounce and three new pennies also weigh one ounce. How could you use a length of elastic to prove this statement? What else would you require?
4. Get a piece of circular cardboard, such as could be cut from a postcard, and make two holes half an inch apart at the middle of the top and bottom edge. Put thin string through the holes in such a way that it can be held in the hands and the string wound up. Draw a parrot on one side of the card

and a cage on the other. Let the card revolve rapidly by allowing the string to unwind. What do you see? Try again with a horse and rider or any suitable pair of pictures.

5. Put a little water in a tall thin jar or bottle and blow across the top to produce a note. Keep adding a little more water to produce more notes. Can you make a rule for the note you make and the depth of water producing it? Is the result as clear if you tap the jar with a spoon?

6. Hold iron, silver, copper and other metal articles such as spoons and nails, and find out which feels coldest to the touch. Find out which gets hot most quickly if dipped in hot water. Now try in cold water to get the opposite results. Try the same experiments with cloth, straw, cardboard and wood. Can you make a rule about which things get hot or cold quickly when in contact with other hot and cold things?

7. Can you balance a pin on the rim of a penny? Stick the pin through a cork and into the cork stick two penknives with half-opened blades. Experiment until you balance the pin on the rim of the penny.



11–*How we hear*

1 Why is it dangerous to get things stuck in your ear?

2 How many sound names do you know like the 'buzz' of a bee?

3 When is it usual to plug one's ears?

4 What happens if you shout when under a bridge?

5 If your friend knocks hard on a telegraph pole, and you put your ear against the next pole, how is it you can hear the knocks so clearly? Can you hear two separate sounds?

6 Do you know the meaning of echo, vibration, microphone and headphone?

Things to do

(Numbers 3, 4 and 5 will need to be done at home.)

1 Hold a watch twelve inches from your ear and listen to the tick. Touch the watch with a twelve-inch ruler and hold your ear to the other end of the ruler. Is the tick louder or softer?

2 Compare your hearing with your friend's by using a watch held at increasing distances from your ear until you lose the sound. You will have to be quiet and honest.

3 Invent as many experiments as you can to find out whether all living things can hear. It will be easy to prove that your dog or cat can hear. Can you find out whether a fish, a butterfly, a fly, a worm, a ladybird or a hamster can hear?

4 Stand in front of a high wall or building and call or clap your hands together. Walk away from the wall and try to find out how many feet you must be away from it before you get an echo.

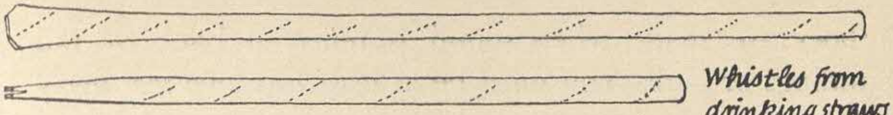
5 When you next have a bath, tap the side of the bath as far away as you can reach. Now repeat this with your ear under the water. Do the same again but this time tap underwater and listen underwater. Experiment in any other way you can think of. What have you found out? If you accidentally swallowed or breathed water into your nostrils in your bath at any time, did you notice that water can flow from your nose into your mouth? Can it come out of your ears? Why not?

6 Run a piece of stiff paper along the edges of a comb with coarse and fine teeth. Which give the lower sounds?

7 Play a tune on your side teeth with a wooden stick, tapping inside your mouth. Make different notes by opening and closing your lips. Why does the sound alter?

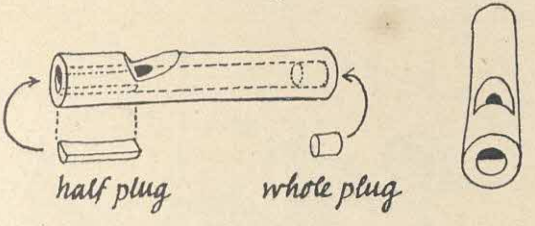
8 Stretch a piece of elastic between your two hands and pluck it to give a sound. Now alter the length as you pluck. Which lengths give out the high notes? The low notes? Do the same thing with a piece of string and a thin wire. Are the notes different if the wire is tight or slack? Can you see the elastic moving?

9 Press the end of a milk straw together to make a flattened oblong, and cut off a little from each corner. Put this end inside your mouth and blow hard. Make another whistle but this time use a piece of different length. What sort of note is produced with a long straw? With a short straw?



Whistles from drinking straws

Flatten the end and cut off the corners. Blow hard



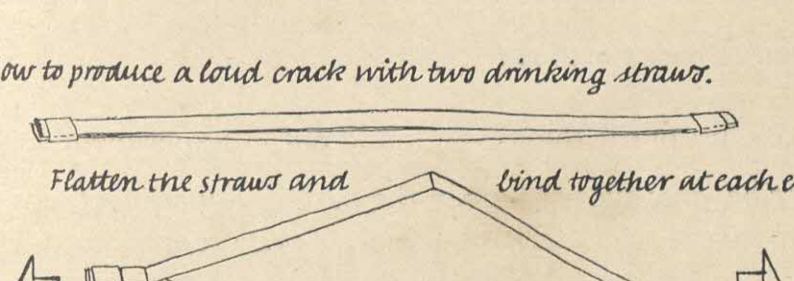
Whistle made from bamboo and pieces of wooden skewer. Cut a V shaped hole. Plug the ends as shown

Things to remember

Different sounds are made by a boy shouting, a clap of thunder, the playing of a gramophone record, the flying past of a squadron of jet planes, and the noise from a crowded playground. In every case, the sounds travel through the air to your ears and your nerves carry the sounds to your brain.

Musical notes are pleasant and are caused by regular and steady vibrations. Slow vibrations give low notes and are caused by the air being moved by thick, long, heavy and loose strings. Quick vibrations give high notes and are caused by thin, short, light and tightly stretched strings. In other musical instruments, reeds or columns of air vibrate.

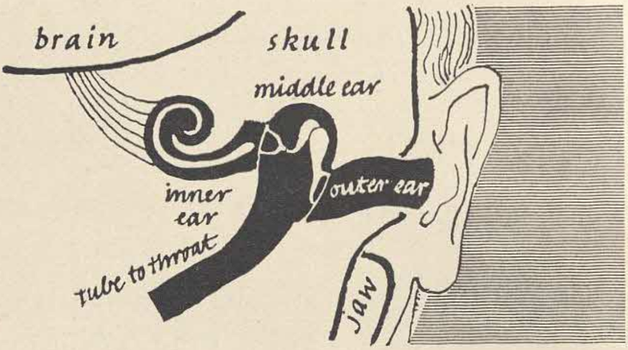
How to produce a loud crack with two drinking straws.



Flatten the straws and bind together at each end.

Push so that they fold outwards. Pull them sharply together.

Echoes are made when sound is reflected back by tall buildings or cliffs. You must be at least fifty-five feet away before you get an echo. Sound travels better through wood, water or the earth than through the air.



How we hear

Sounds we hear are caused by the movement backwards and forwards (called vibration) of the air passing into the outer ear and hitting the ear-drum. The ear-drum then vibrates at the same speed and the small bone, called the hammer, strikes on the bone called the anvil and the stirrup bone carries the sounds to the inner ear. From here, the sounds are taken by nerves to the brain, which is able to change these vibrations into the different sounds we hear and recognise.

In your Science Notebook

1. Make a list of the things you found out in Experiment 3.
2. Describe your experiments in the bath in Experiment 5 and try to give a scientific explanation of your results.
3. Collect or draw pictures of different musical instruments and say how the sounds are produced and controlled.

12 – *The scientist looks at life: How creatures live together in a pond or aquarium*

1 How are ponds formed? Why doesn't the water run away?

2 Name any living creatures which you know live in or near a pond.

3 What are the uses of plants in and around a pond?

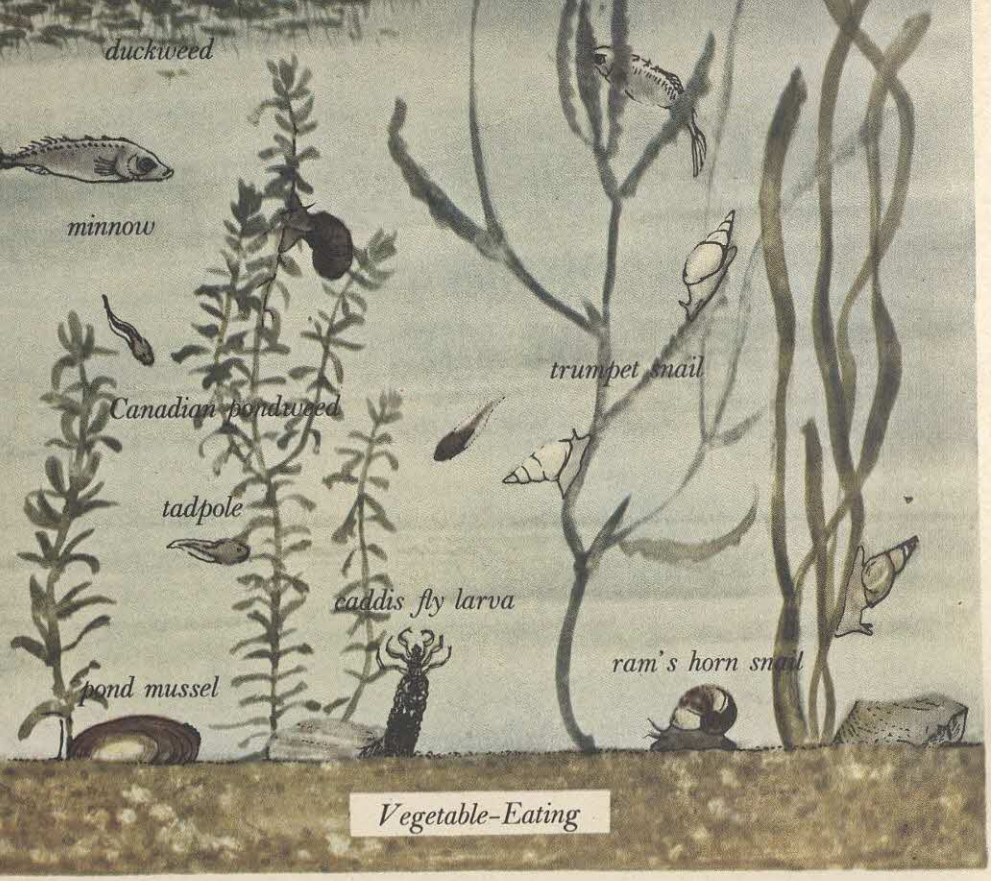
4 Can all the pond creatures live underwater all the time?

5 How do pond creatures protect themselves?

Things to do

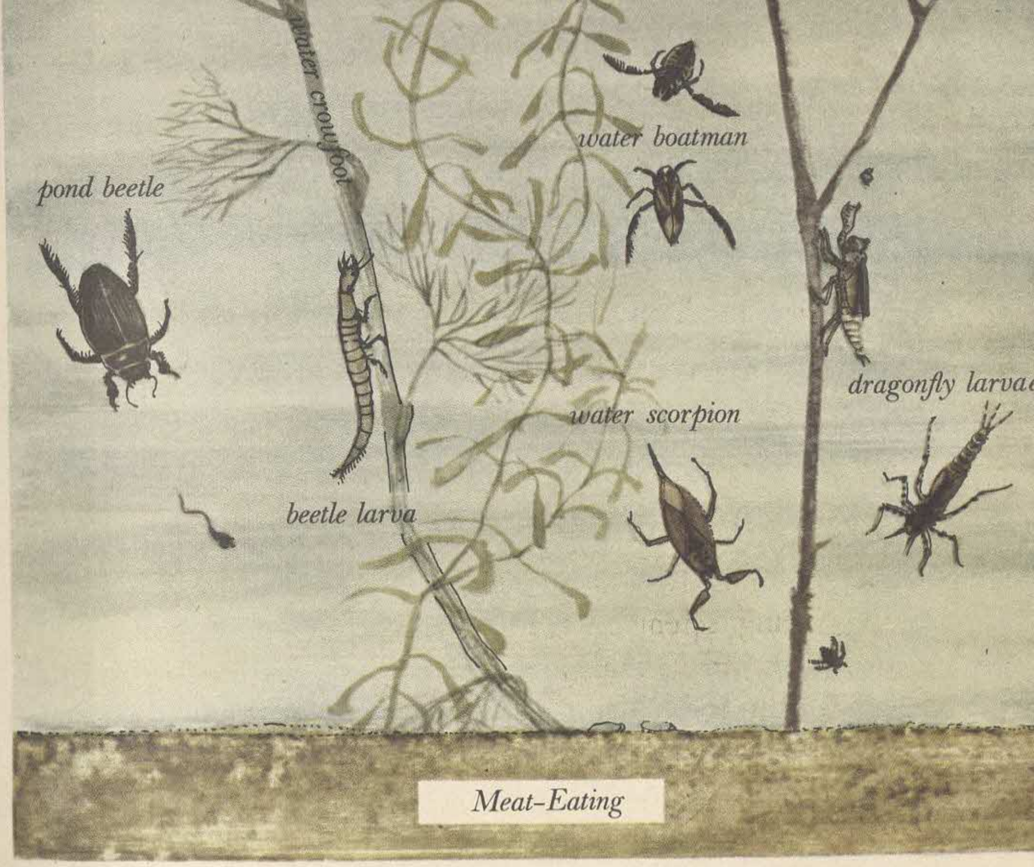
1 If you can visit a pond, you must arrange for your group or class to work as a team. Visit it first and make a survey. Mark sections for different children to study. You can draw a sketch map on a large cardboard sheet and then cut it up and give each young scientist a piece. Write your notes on the cardboard, then reassemble the map when you get back. Your teacher will tell you what to take to catch the creatures and how you can bring them back for study. Many visits must be made to find out the names of:

a) trees, water weeds and marsh plants and their positions,
b) birds,
c) animal and insect life in the pond.



2 Examine each creature separately. Keep it in a glass container. Use your lens to find out its colour, size, how many legs, wings and parts to its body. Look at the shape and size of its head and eyes. Watch how it swims. Does it come to the surface for air? Find out the names of all your specimens and read about them. Butchers' white trays are very useful for examining the specimens.

3 Make an aquarium to keep an indoor 'pond'. Any glass tank 18 inches by 10 inches by 10 inches or about 24 by 12 by 12 will be a good size. Keep it facing north out of bright sunshine and cover three sides with brown paper, or paint three sides green. Wash it out well first with hot water, and



then put three inches of well-washed coarse sand or aquarium compost in the bottom. Arrange water weeds by fixing them in the sand with small pieces of lead. Cover the sand and weeds with a sheet of cardboard so as not to disturb your sand and plants, then gently pour in tap water on the cardboard before removing it. Leave to settle for two or three weeks. Put a little floating weed on the water and add a few stones. Put in your creatures and cover with a sheet of perforated zinc or glass with its corners resting on four corks or pieces of Plasticine so that there is a wide space for air. Read in your reference book about creatures which eat other creatures and cannot be kept with their victims. You will need two tanks if you wish to keep both kinds.

4 Put some moist bread paste on a piece of glass with a snail. Look beneath the glass to see how the snail moves and eats. How could you watch a meat-eating creature feed?

5 Make a class Pond Book and in it keep a record of all you learn about the pond. Make drawings of your specimens.

Things to remember

A pond is a little world in itself where trees, small plants and animals live all the year round and can be studied by the young scientist. Water-loving trees and small plants grow around it, and many float on the water, shading the pond from the hot sun. The plants provide the food of some of the animals in the pond. Frogs, toads and newts live in or near the pond. Many kinds of insects start their lives as eggs and larvae under the water. The pond itself is alive with a multitude of different creatures, some gentle, some savage, but all worth study. Sticklebacks build their nests in the pond. The water spider carries bubbles of air down to its nest to keep its young alive.

Did you know that . . . ?

The age of fish can be found by examining their scales, which show annual growth rings. (You will remember from Book 1 that trees also make growth rings.) The common goldfish lives up to 30 years, the stickleback 3 years, tropical fish 3 years (occasionally up to 10 years), and carp, in the wild state, 15 years. Sticklebacks usually have 3 spines, often 10 and very occasionally 7 and 12.

In your Science Notebook

1. Draw a plan of any pond you can visit and make notes of your discoveries around it, or draw your aquarium and label all the things inside it.
2. Use one page for each of the creatures it is your team's job to study and make careful drawings of it. Use reference books to find out more about your creature and make notes of all the new information you are able to discover. You will then be able to refer to your notes when you make your personal contributions to the class Pond Book.
3. Make drawings of all plants, birds, trees, etc., which live in or around a pond or stream.

How much more have you learned? **Test two**

1. Put suitable words in the spaces:
   In a hot-water system, ——— is used to heat the ———
   in the ———.
   ——— water is lighter than ——— water.
2. Write down the word TRUE or FALSE for each of the following sentences:
   a) An electric battery stores electricity.
   b) An electric lamp gives light but not heat.
   c) A torch battery can be re-charged with electricity.
   d) If electricity is passed through a copper wire around an iron article, a magnet is made.

3. Put the words 'weather' and 'climate' in the correct spaces in the sentences:
   a) ———— is the daily state of the air in a certain place.
   b) ———— is the ———— a place has over a number of years.

4. Rearrange the following to make sensible sentences:

a) The wind and the sun	breathe out water.
b) Warm air	rain begins to fall.
c) When clouds become cooler	affect the weather.
d) Water evaporates	rises.
e) All animals and plants	from lakes and ponds.

5. Put these words in the right sentences:
   electricity clouds lightning copper earth thunder
   a) Electricity always tries to get to ————.
   b) ———— can be made by rubbing things.
   c) ———— is followed by ————.
   d) Lightning conductors are made of ————.
   e) Tiny drops of water in the ———— make electricity by rubbing together.

6. Fill in the blanks:
   Sounds we hear are caused by the vibrations of the ———— passing into the outer ———— and hitting the ————. The ———— then vibrates at the same ———— and the small ———— called the ———— strikes on the ———— called the ————, and the ———— ———— carries the sound to the ———— ear. From here, it is carried by ———— to the ————.

7. Write down the names of one tree and two smaller plants which are often found growing near a pond or stream.

13 – *The scientist looks at life: Friends and enemies of the gardener*

1 How many creatures can you name which are born and spend their lives in your own or a friend's garden?

2 Do any of these look like each other? Do they look as though they belong to the same family?

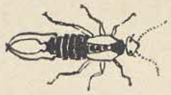
3 How does Science help us to get over silly fears of 'creepy crawlies'?

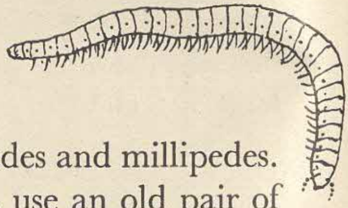
4 Which of the creatures are friends or enemies of the gardener?

Things to do

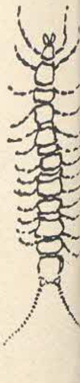
Divide your class into groups to study and tell each other about the different creatures found in the garden. Collect medicine bottles, biscuit tins, small jars, matchboxes and the like to make vivaria (containers in which creatures are kept in as near to natural conditions as possible) for the creatures to live in, and small inspection jars or boxes to examine them separately. A matchbox with a cellophane window makes an excellent study box for one small creature, but no doubt you are now able to invent your own. Here are some suggestions for dividing the work, but make your own arrangements if you can think of any more suitable. Each team should make notes of all discoveries.

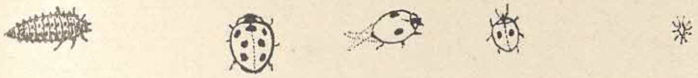
Team One. Become an expert on earwigs so that you can pass information on in sketches and talks. Collect specimen earwigs. Put one in a tin or box and examine it carefully. Is it an insect? How do you place creatures in the insect family? Are the pincers the same in all earwigs? If there is a difference, can you suggest any difference between the earwigs? Measure the length of your earwig from the tip of its antennae to the pincer tip. Examine its eye under your lens. Can you find out how many pairs of wings the earwig has? Have you ever seen an earwig in flight? Make an insect case for your earwigs and see if you can breed them. Feed them on decaying leaves.



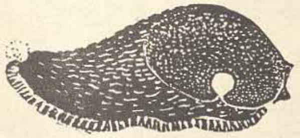


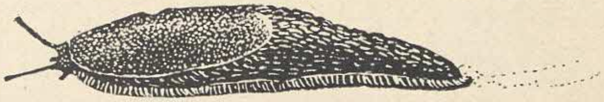
Team Two. Look under stones for centipedes and millipedes. (If you do not want to use your fingers, use an old pair of eyebrow tweezers.) Look at them separately with your lens. Does the millipede move slowly or quickly? How many sections are there to its body? How many legs on each section? Has every section legs? Count from the head and find out which segment has no legs. Is this usual? Compare other millipedes to find out. Is the millipede smooth or rough? What does it do when disturbed? Can you find its little group of eyes? In early summer, watch for eggs being laid. After twelve days, watch for them hatching. Look at one centipede. How many legs to each segment of its body? How many segments? Less or more than the millipede? Does it move quickly or slowly? Can you see its legs moving when it runs? Make sketches and notes.





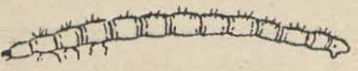
Team Three. Collect ladybirds and greenflies from plants. Examine one of the ladybirds carefully with your lens. How many spots? Draw your ladybird. Try to find clusters of little yellow ladybird eggs on a plant which has greenfly. Put them with the leaves in an insect case and watch for the larvae hatching out. How many legs have they? Feed them with greenfly and see how many they can eat in one day. Keep a diary. How long is it before the larva stops growing? What is its colour then? Does the colour change? How does it hang from a leaf? How many days go by before the ladybird comes out of the pupa? Which end of the larva splits first? Make notes and drawings of all you learn and prepare large sketches for display on the Investigation Table with live specimens. You might like to give a talk to the other groups.





Team Four. Collect garden slugs for study. Keep them in a box of moist soil with a grass sod partly over them. Give them fresh lettuce every day. Examine one slug on a piece of glass. Turn the glass over and watch from underneath how the slug moves. What sort of skin has your slug? Is it smooth or wrinkled? Has it a sort of shield on its back? Can you recognise its one and only foot? Has the foot a coloured fringe to it? Why do you think a slug gives out slime when it moves? Are the tentacles swollen at the top?

What happens if you touch them? Can you find a hole through which your slug breathes? Draw your slug and label and colour the parts you have discovered. Find out all you can about slugs and snails from reference books and make notes.



Team Five. Dig in the garden for a wireworm and inspect one with your lens. How long is it? What colour is it? Draw it. How many portions to its body? How many legs? Which parts of its body are its legs fastened to? Can you find its extra foot? Keep your wireworm in an insect case and provide soil and plants. Watch every change in its growth and make records of them all.

Other teams can choose their own examples and work in the same way, for example, with spiders, snails, beetles, woodlice and ants.

Things to remember

Our gardens contain many interesting creatures. They can usually be sorted out into families. Some are friends and others enemies of the gardener. An earwig hides during the day and feeds on plants at night. It is no more likely to get into your ear than any other insect.

Wireworms are the larvae of the click beetle. They do great damage to young plants.

Ladybirds are very useful to gardeners because they feed on greenfly which suck the juices of plants. The two-spotted and seven-spotted are the commonest.

Slugs spend the day under stones and feed at night on the gardener's plants. They can make a rope of slime and climb up and down it. They lay a very great number of eggs and are a great pest to the gardener.

Millipedes feed on plants. They are slow-moving but do great damage to seedlings. Centipedes are quick, active creatures and live on smaller insects and slugs. They are friends of the gardener. They kill their food with their strong, poisonous first pair of legs. Everything is not yet known about all the creatures in a garden. A young scientist can discover new things by careful study and can add to the knowledge we already have.

In your Science Notebook

1. Make fair copies of your drawings and notes collected during your observations and those of the other teams.
2. Make notes or drawings of plants found in the garden which have been damaged by caterpillars, earwigs, mice, etc.
3. Find out how creatures in the garden protect themselves from their enemies, and write an account in your notebook.
4. Try to find out how far a snail moves in a given time, and work out its speed.
5. Make a class reference book with chapter headings and an index. Share the work between the members of your team.

How to train yourself to be a good scientist

Fourth: Can you think and find out?

1. How many things are there in your home or in school:
   a) with square tops or bottoms?
   b) with circular tops or bottoms?

2. Use a directory or reference book to find out the names of:
   a) the first man to fly alone across the English Channel
   b) the first woman to fly alone across the Atlantic
   c) the first person to reach the North Pole
   d) the first persons to climb Mount Everest

3. You live in a house. Find out as many different names as you can for the homes of animals (including birds and insects).

4. Which is the incorrect figure or letter (one in each case) in each group?
   a) 3 6 9 11 12 15
   b) 1 3 6 8 10 13
   c) A C E F G I
   d) X C W D V E T F

5. Find out as many differences as you can between:
   a) the moon and the sun
   b) a swift and a swallow
   c) a toad and a frog
   d) an African and an Indian elephant

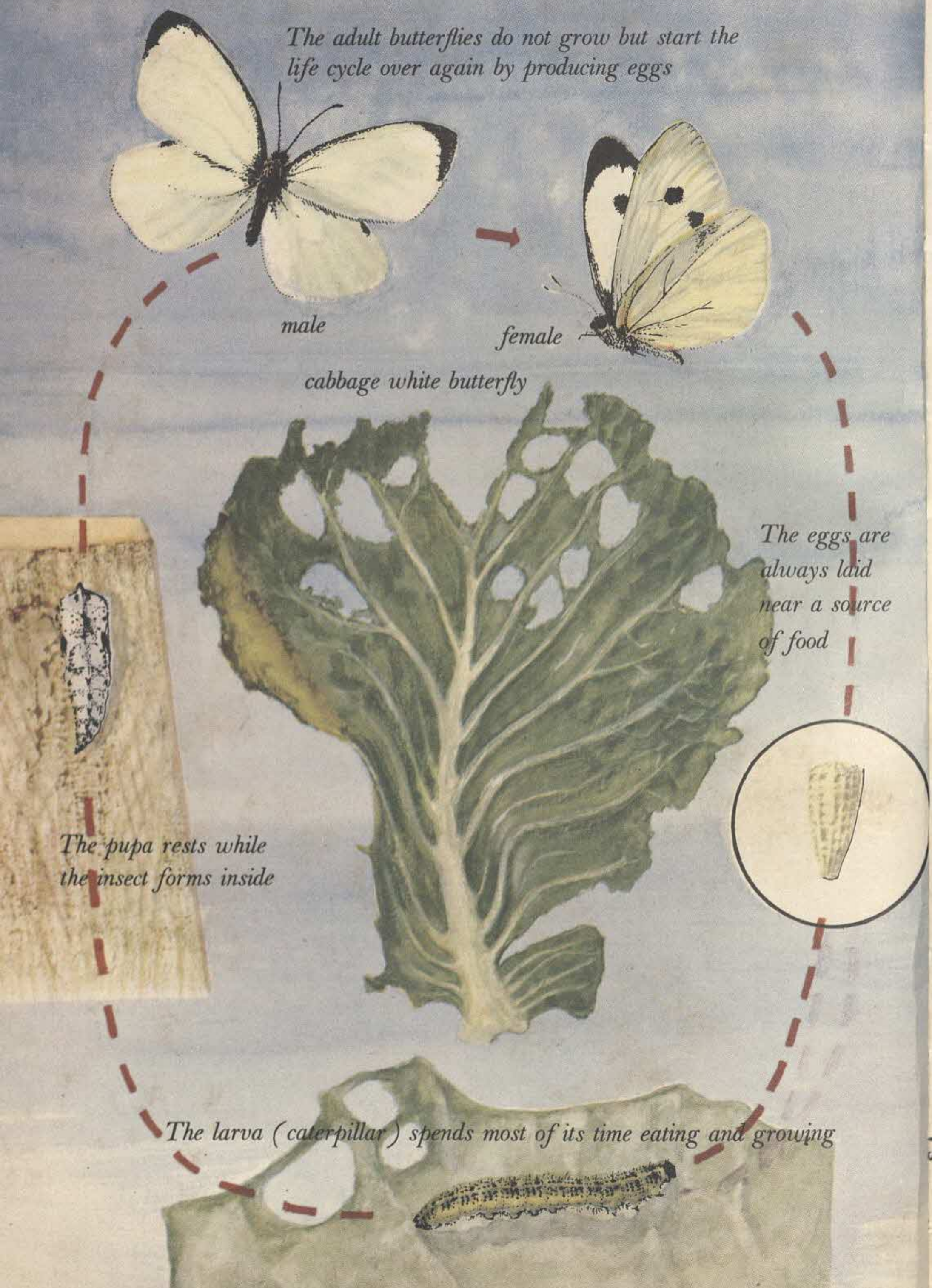
6. Can you explain why:
   a) a robin seems to look bigger on cold days than on milder days?
   b) an oak tree has so many acorns?
   c) there are spaces between the lengths of a railway line?

7. What is there unusual about
   a) a homing pigeon?
   b) a tortoise in winter?
   c) a mushroom?
   d) a holly tree in winter?

8. How many odd figures are there between:
   a) 0 and 10?
   b) 0 and 100?
   c) 0 and 10,000?
   d) Can you find out the rule?

9. Which letters of the alphabet do you think are used most and which least in your reading books? Why do you give the answer you do? Would you need to count all the letters in the book to find out?

10. A large cube is made by sticking together 27 smaller cubes, all of the same size. The large cube is then painted red on all six sides. If the cube is now broken up into its smaller cubes again, how many small cubes have paint
    a) on no sides?
    b) on one side?
    c) on two sides?
    d) on three sides?



The adult butterflies do not grow but start the life cycle over again by producing eggs

cabbage white butterfly

The eggs are always laid near a source of food

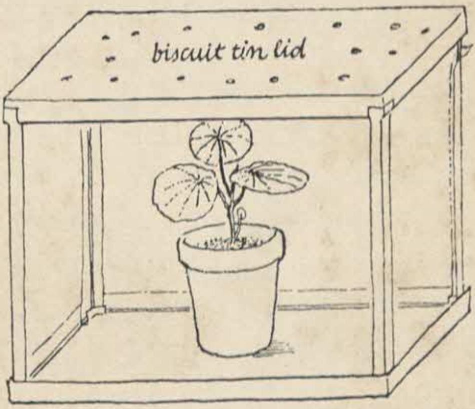
The pupa rests while the insect forms inside

The larva (caterpillar) spends most of its time eating and growing

14 – *The scientist looks at life: How the cabbage white butterfly grows*

1. Where can you find the eggs of this butterfly?
2. Why does it lay them there?
3. What are the differences between a moth and a butterfly?
4. Is the cabbage white butterfly a nuisance?
5. What markings has a cabbage white butterfly? Can you describe any other butterfly?
6. On what sort of day do you see butterflies flying?

Things to do



1. This is how to make an insect cage to breed your butterflies. Get two strong cardboard or biscuit tin lids. Measure the length of the sides and get four pieces of glass to use as shown in the sketch. Ask for them to be cut exactly so that you have a box when they are used with your two lids as the top and the bottom. Fasten the sides and bottom with very strong sticky tape. Punch some air holes in the lid. Put water or damp soil in a small jar to

hold a plant. You can cover the top of your jar with a piece of cardboard with a hole in the middle for the plant.

2 Eggs can be found in May–June and again in July–August. The May ones will hatch the same summer, but you will have to wait until next year for the July ones. Examine the eggs with your lens. Draw them. Leave them on the plant in your insect case.

3 Your May eggs should hatch in seven to ten days. Watch the little caterpillars. What is the very first thing they eat? Make a diary of their growth.

4 Examine a fully grown caterpillar. How long is it? How many sections to its body? How many walking feet has it? What do you think cushion feet are? How many has it? Watch how the caterpillar moves. Examine its head and eyes under your lens. Draw and write about all you discover.

5 In June, your caterpillar will be ready to change again. How long does it remain very still? Watch everything it does very carefully. Does it begin to climb? What is its zig-zag ladder made of? Try to see the change to a chrysalis. We say the caterpillar has pupated or changed into a pupa. Draw it now. Try to change the colour of a pupa by putting coloured paper (red or black, perhaps) around the sides of another cage when the caterpillar begins to climb.

6 In about three weeks your pupa will split. Watch the butterfly as it comes out. Does it have a hard struggle? What are the wings like as it does so? What changes them? Draw your butterfly and mark in colour all its different parts. Look at the wings under your lens. Examine its head carefully. Has its body kept the same number of sections as the

caterpillar had? Watch butterflies in the garden or fields. Note how they fly and alight. Try to see them feed. Try to find out the different markings of the male and female. When you have done so, watch carefully the female in flight and see where she lays her eggs.

7 If you wish to do more work on insects, collect caterpillars of different kinds of butterflies and moths and watch their growth from eggs to insects in your cages. You may like to study a different one at home. Always have supplies of the fresh leaves on which you can find them. Can you think of a way of making a better cage than the one we suggest? For example, try cardboard boxes and differently shaped tins or wooden boxes.

8 Make a Butterfly and Moth Book. Collect drawings and notes of all the different kinds you see. Keep a diary showing where and when you saw them, on which small plant or tree, their habits, their colour and so on.

Things to remember

The cabbage white butterfly lays its eggs on cabbage or nasturtium leaves in either spring or autumn. The egg changes into a caterpillar which eats and eats until it splits its skin. It eats and grows again, and moults four or five times altogether. Next the caterpillar weaves a silk covering for itself and becomes a pupa (or chrysalis). At last, the butterfly comes out. It has four wings, three pairs of legs, two feelers and a tongue shaped like a spring. It lives on nectar from flowers and soon begins to lay eggs. The life cycle of the cabbage white butterfly has begun again.

15 – *Nature's ploughman: How the earthworm lives*

1 Where would you find the greatest number of earthworms —in sand? After rain? At night? In damp soil? In dry soil? In rich soil?

2 How can you tell if worms are living in your garden?

3 What does a worm live on?

4 Has a worm any bones? Any teeth?

5 Why does a worm coming up for food often leave its tail just inside the top of its tunnel?

6 What are the enemies of the earthworm?

7 What colour is an earthworm's blood? Why is the earthworm's skin always moist?

Things to do

1 Make a wormery. You may use a large jam jar covered with brown paper to exclude light, or a wooden box with one glass side. Fill the wormery with layers of fine sand and garden soil. Put some dead leaves on the surface and keep the soil damp. Introduce two or three worms. Watch them carefully. How do they make their homes? How do they carry their food? How is a worm cast made?

2 Put one of your worms on a piece of newspaper. Notice its colour. Hold it to the light. How many rings are there on

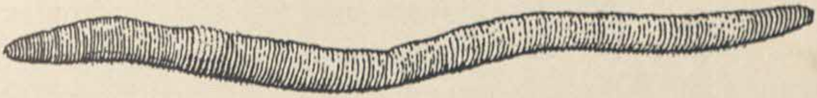
its body? Examine the two ends. Can you find a mouth? Ears? Teeth? Eyes?

3 Note carefully how the worm moves. How does the worm grip the paper? Listen carefully as it moves. Can you hear anything? Pick up your worm and gently feel down its body from end to end. Can you feel anything?

4 Put your worm first on paper then on glass. Let it move on both. Can it move at the same rate on each?

5 Measure the length of your worm with a piece of string and a ruler. Which is the longest worm you and your friends have found? Which is the shortest?

6 Go out into the garden at night with a torch and look for worms. What are they doing? Do they feel you if you touch them? Do they do anything if you shine your light on them? If they do, how do you think they know the light is there if they have no eyes? Can they hear? Make up an experiment to prove whether they do or not. Stamp on the soil some distance from worms. If they move as though disturbed, how do you think they know you are stamping if they have no ears? Which kind of night is best to try to catch worms?



Things to remember

Earthworms usually live within eighteen inches of the surface of the soil although they have been found six or seven feet down. They prefer rich soil and make tunnels in the ground which break up the soil and help the plants to get air and water. Earthworms live on soil and leaves. They take food from the soil and then leave very fine soil on the surface in worm casts. In one acre of rich pasture, there may be three million earthworms.

The earthworm has a small slit in its head which it uses for a mouth, but it has no teeth. It pushes through soft soil to make its tunnel and can eat its way through hard soil. It has four lines of bristles on the underside of its body to help it to grip the ground and move. The front end is stretched out long and thin. Then it is shortened and thickened and so the worm moves. An earthworm has no eyes, but its skin is sensitive to light. Usually it hides away during the day and comes out at night. When it finds a leaf, it pulls it underground with its mouth and will go all round a leaf until it finds the narrow end so that it is pulled more easily into the hole. If cut by a spade or pecked by a bird, an earthworm can usually grow a new head or tail. The earthworm lays small yellow eggs.

In your Science Notebook

Write an account of your discoveries about the earthworm, and make some drawings to illustrate your work. Try to read about Darwin's experiments with earthworms and write an account of them.

16 – *Why things fall over*

1 Why is it easier for a calf to begin to walk than it is for a baby?

2 Why is it easier to ride a three-wheeled cycle than one with two wheels?

3 Why is it easier to knock down a boxer when his feet are close together than it is when they are planted apart?

4 What is meant by 'top heavy'?

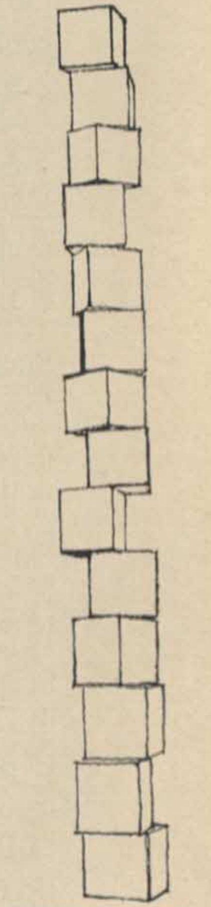
5 Why should you never stand upright when changing places in a rowing boat?

Things to do

1 Experiment with a toy motor bus to find out ways of making it overbalance. Let the bus run on different kinds of slope. How does increased speed affect it? Look at different kinds of car, vase, chair, etc., to see how they are made steady. Why are some things very safe while others fall over easily?

2 Try to balance an empty bottle on its top, sides and on its bottom. Balance a book in as many different ways as you can. When do things fall over? When will they not fall over? Can you make a rule for this?

3 Build towers of toy blocks, dominoes or threepenny pieces and experiment to see when they are safest and when they are most likely to fall over.



4 Put a long piece of wood, such as a ruler, on a table and slowly push it over the edge. When does the ruler just balance? When does it begin to fall over? Stick a piece of lead or an iron nut on the end of your ruler with Plasticine. Does the ruler balance in the same place? A milk straw weighted with Plasticine will work just as well.

5 (An experiment to do at home.) Make a large hole in the end of an egg. Prick the yolk with a clean needle and empty the inside of the egg into a cup to be used up in cooking. Wash out and dry the eggshell. Run in some dry sand. In another eggshell, put small pieces of lead and either run in some melted wax, or a paste of plaster of Paris. Cover the hole with a paper face and hat. Put it on a table and move it about. Explain the behaviour of your Humpty Dumpty.

6 Stand on one leg. Stand on two legs. Stand with both feet together, then with both feet apart. Stand with both heels against the wall and try to touch your toes. What do you notice in each case?

Do you have pushing contests in P.E. with hands against your partners? This is how to hold back even a heavy adult. Put one leg behind the other and as your opponent starts to push, tilt your hands by bringing your finger nails towards your body. Your opponent will then be trying to push your back heel through the ground. When you decide to push, you will be pushing slightly upwards and will easily push him off balance. Until you give him the little tip about tilting back the hands, he will be very puzzled.

7 Use your toy motor bus again to see when it will fall over when loaded. First fasten a heavy weight on the base of the bus and then try to tilt it over. The best weight is a strip of lead. Now try with a heavy weight on the top of the bus.

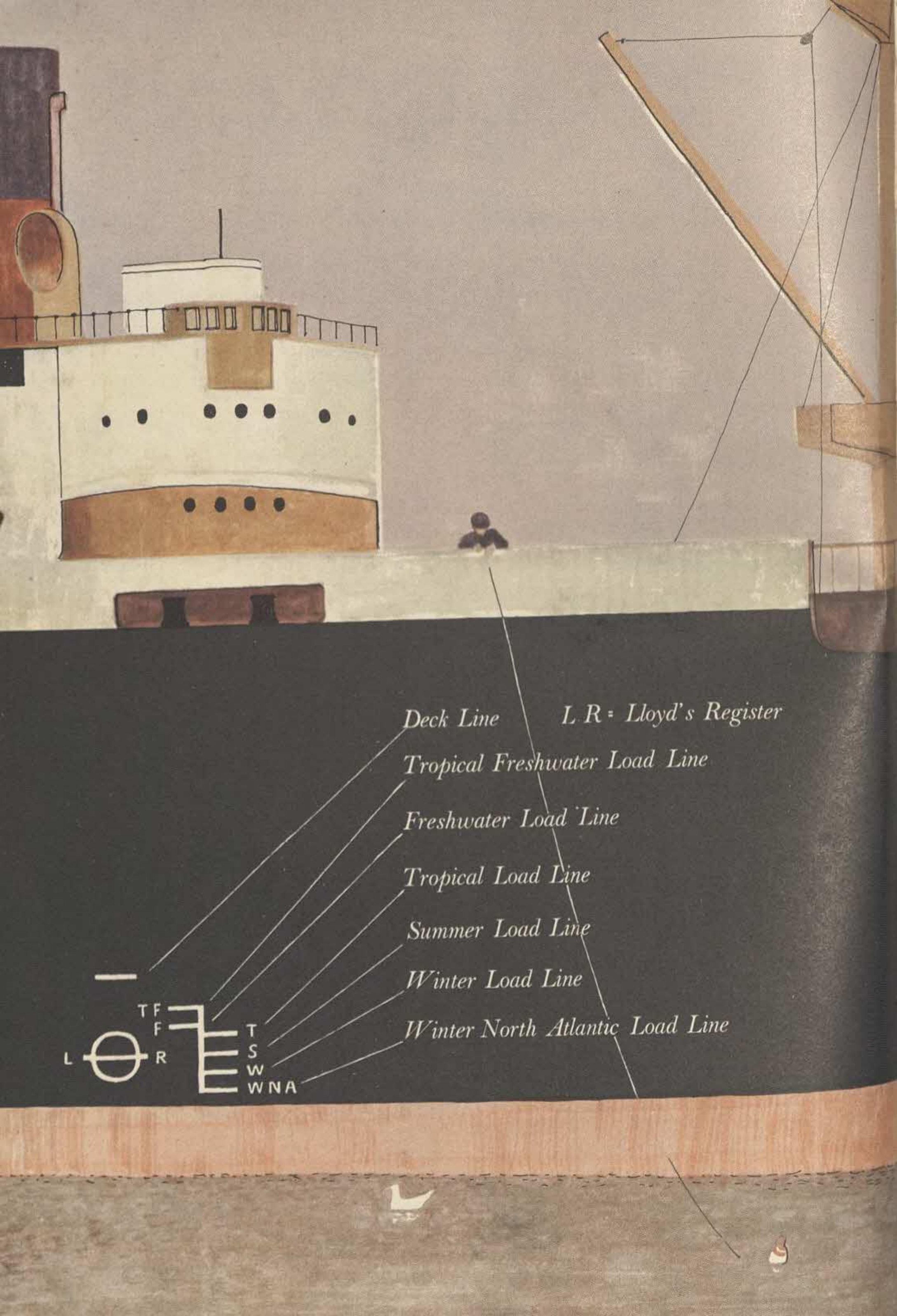
Things to remember

Some things fall over easily. Other things are stable and firm and are difficult to knock over. Things that have a wide base are less likely to fall over than those with a narrow one.

Things that have most of their weight low down are heavy at the bottom and are not easily knocked over. A bus is therefore safest when the wheels are as far apart as possible and when the heavy engine is placed as low as possible in the chassis. When you alter the position of your feet to keep your balance, you are really spreading your weight over a wider base.

In your Science Notebook

1. Make two lists showing things which fall over easily, and things which do not.
2. Draw a penny-farthing and a modern bicycle. Underneath them, say why the modern bicycle is easier to ride.
3. Make simple diagrams of your toy motor bus at various angles of tilt and with weight in various places. Try to find out where and how the double-decker motor buses are tested for balance and make notes of your discoveries.


Deck Line
L R = Lloyd's Register
Tropical Freshwater Load Line
Freshwater Load Line
Tropical Load Line
Summer Load Line
Winter Load Line
Winter North Atlantic Load Line
TF
F
L
R
T
S
W
WNA

17 – *Why things float*

1 How many different things do you know of which will float in water?

2 Why does a piece of iron sink in water while a ship made of iron floats?

3 How much of an iceberg floats above the level of sea water?

4 What is a life jacket? What is it made of? Why?

5 Why is it easier to swim in salt water than in fresh?

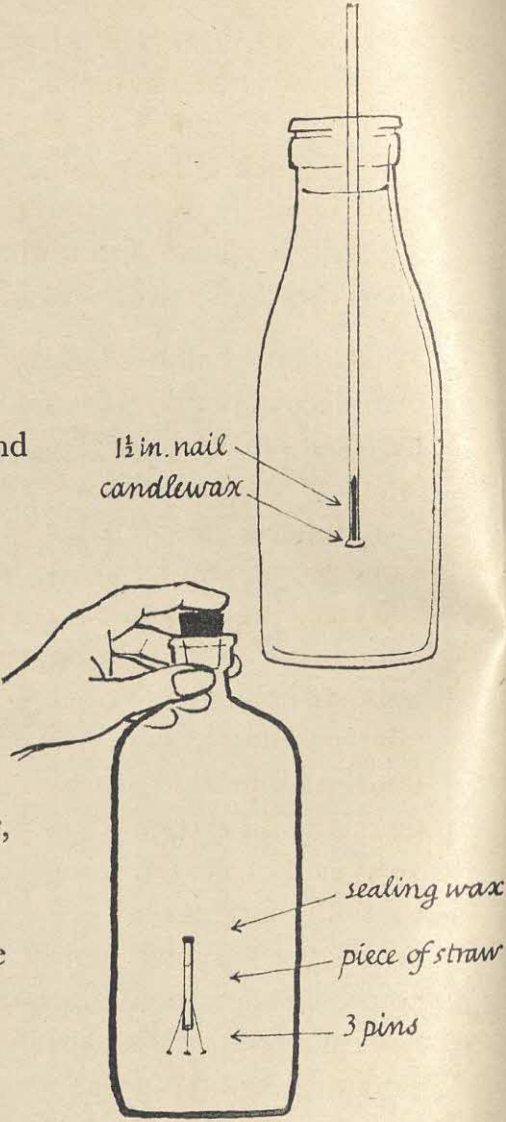
Things to do

1 Try to collect cubes of different kinds of wood and float them in a bowl of water. Try also to float a cork, a nail, a penny, a tin lid, straw, a piece of folded paper, crumpled paper, unfolded paper.

2 Drop pieces of aluminium, Plasticine or thin 'tin' (really iron coated with tin) into a jar of water. Do they float? Now make them into the shape of a little boat. Can you make each float? Why is this?

3 Put a tin-can, with its lid firmly on, into a bowl of water. Press the can to the bottom with a pencil. What can you feel? Does the can stay at the bottom or does it try to get back to the top? Take the lid off and put a little sand in the tin. Now float it on the water. Keep putting more sand into the can until it sinks again.

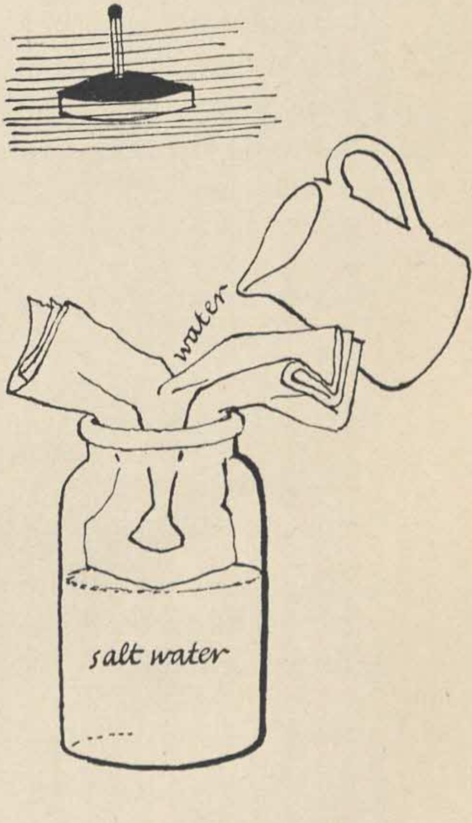
4 Press the end of a milk straw together and dip it into melted candle wax. When it cools, test it in a jar of water by blowing down it to see that it is air- and water-tight. You will see bubbles if it is not. Gently press a small piece of Plasticine on the waxed end (or add three lead shots) so that the straw will stand up and float in water. Try floating your milk straw in strong salt solution, paraffin oil, milk, hot water and cold water and mark the levels of the liquids on the straw with a coloured pencil.



5 A Cartesian or 'magic' diver is best made from a nose dropper, small enough to fit into a medicine bottle. First draw just enough water into the tube of the dropper to allow it to float. The diver will sink in a medicine bottle full of water when more water is forced into the tubing (by pressing on the cork) or will rise when water flows out (by releasing pressure on the cork). It therefore rises and falls like a submarine. A milk straw or the end of a feather quill will give the same results if care is used.

6 Float a tall, narrow tin weighted with coins or stones in a jar of water. Mark the height of the water on the tin. Now float it in a similar jar but filled with salt solution (water with as much salt as possible dissolved in it). Mark the liquid level again. Is there any difference? Use a strip of wood or a pencil weighted with lead and mark the levels at which it floats in water, salt water, milk and any other liquids.

7 Make a little 'submarine' out of a piece of potato. It should be about one and a half inches long and you can stick a small 'match periscope' in it. Take a one pound jam jar nearly full of water and put your 'submarine' in it. Take out the 'submarine' and add three tablespoonfuls of salt. Stir well. Put the submarine in again. Is there any difference? Now pour away half of the salt water, cover the surface with newspaper as shown, slowly pour cold water on to the paper and then remove the paper carefully. Again put the submarine in the water. What has happened? Why?



8 Bring as many boats to school as you can and arrange to try them out in a tank of water. Examine their shapes and weights and try to account for the differences.

Things to remember

Light things, such as cork and wood, float in water, but heavy things made of stone and iron sink. A tin-can floats because it is hollow and contains air. Hollow things like ships and boats may be made of steel, but the air inside them makes them buoyant. A stone weighs less if lifted in water than in air. It is easier for you to float in sea water than in fresh water in a swimming pool. Ships float deeper in river water than in sea water. Ships have much of their weight deep down to make them safe. A submarine can be made to rise or sink in the sea by pumping water in or out of special chambers so that the submarine becomes heavier or lighter.

In your Science Notebook

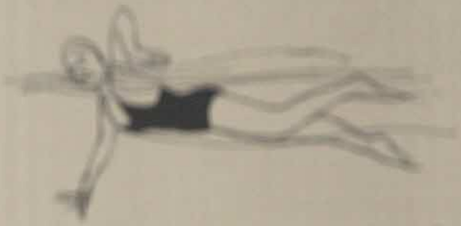
1. Write an account of Experiments 1, 2 and 4, and draw sketches to illustrate your accounts.
2. Find out all you can about a submarine or a lifeboat and draw a picture showing the different compartments.
3. Find out all you can from an encyclopaedia about Plimsoll (when and where he lived, what his work was, etc.) and enter your findings in your notebook.
4. Make a class reference book on 'Floating things'. Divide the work into chapters amongst your friends.

Did you know that . . .?

The largest iceberg was one seen in 1955 in the Antarctic and had an area of 200 square miles, that is, equal in area to a square whose side measures almost 15 miles.

Heart-beats

Dawn Fraser, the Australian swimmer, has a lung capacity one-tenth greater than the average woman. Her heart-beat, when first waking up, is between 42 and 44 instead of the average 65 to 70 beats per minute.



Legs

You have two legs; a snake has no legs; insects have six; a spider, eight; a centipede usually 30 to 40 (not 100); a millipede usually 36 to 160 (not 1,000).

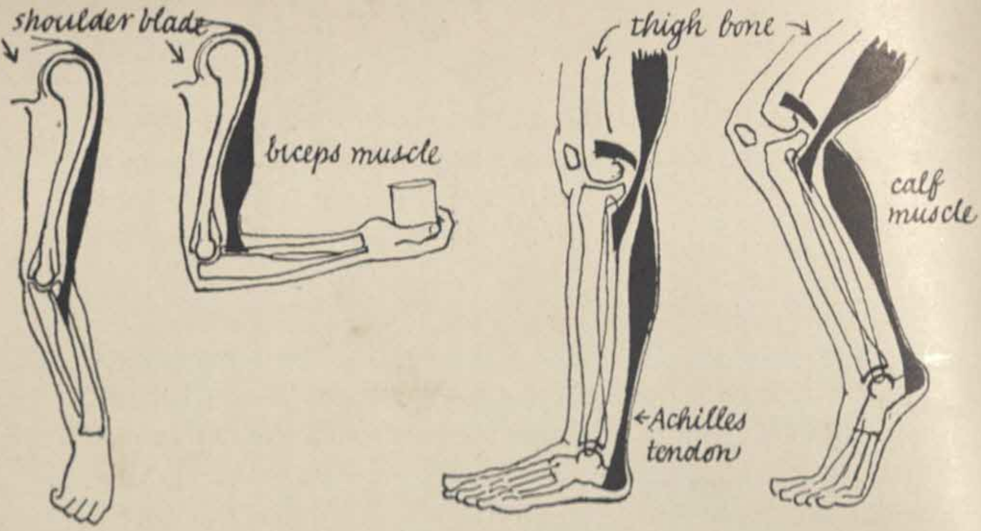
Blue skies and white clouds

The blue of the sky is caused by the light from the sun which is scattered by tiny particles in the air.

White clouds look white because they are formed of tiny drops of water or crystals of ice which reflect equally all the white light of the sun.

Beaver!

The hair on a man's chin grows about six inches every year. A man who shaves for fifty years grows enough hair on his chin for a beard 25 feet long.



18 – *How your body works*

1 What is a skeleton? Does every living thing have one?

2 How many senses have you? Name them.

3 What creatures do you know which have certain senses keener than those of human beings?

4 Why is it difficult to taste food when you have a cold?

5 Can you think of any jobs which require one of the senses to be well developed?

Things to do

1 Look at a picture of the muscles of the body. Can you feel any of them with your fingers? Bend your arm and show how big your biceps muscle is. Turn your head about while feeling your neck muscles. Make your stomach move in and out with your stomach muscles. Can you find tendons in your leg?

2 Look at the picture of the human skeleton on page 95 and try to feel as many of the bones as possible in your own or a friend's body. How many different ways can you move your arm at the shoulder joint? At the elbow joint? At the hip joint? At the knee joint? Stretch your leg out and waggle your knee cap. Can you do this with your knee bent?

3 Put a mark with Indian ink on your finger nail where it begins to grow out of the skin. See how much the nail grows in one week. How long does it take to grow an inch? Do you need to go about with a horribly long nail to find this out?

4 Soak a piece of cotton wool in ink and take a finger-print by putting your finger first on the ink and then on a piece of paper. Compare your finger-prints with those of your friend. Use your magnifying glass. How does a detective use finger-prints? Does he ever use foot-prints? Can you recognise the foot-prints of any birds or animals? The next time it snows, make observations and do some detective work on different prints.

5 Test your own eyesight. Put a calendar or piece of news-print on the wall and test each eye separately by closing one in turn at different distances. Make up tests outside with your friend to find out who can see clearly for the furthest distance.

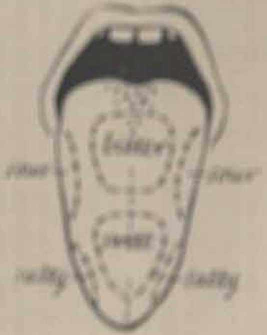
6 Cover a line of this page with a piece of paper so that you can see only the bottom half of the letters. Try to read the line. Now cover the line with the top half showing. Which part of words do you usually read? Try also printing and reading the top and bottom halves of words.

7 Hold one hand above your head for a time, then look at the back of it before holding it hanging down at your side. Do you see any difference? If you do, can you give a reason for the difference?

8 Gently touch your skin with two pins held close together. Can you feel two pricks? Gradually widen the distance between the two points. What do you notice now? How do you think the feeling is carried to your brain? Try the points on different parts of your body. Are some more sensitive than others?

9 Do the same at different points on your body, but use this time a large nail which you have heated in hot water. Is your skin more sensitive to heat at some points than at others?

10 Dip a clean painting brush into water with a small amount of sugar dissolved in it and brush your tongue at the places marked in the sketch. Put some cotton wool in your nose first to stop you mixing up smelling and tasting. Rinse out your mouth and clean your brush, then do the same with vinegar. Repeat the experiment with salt, lemon juice and alum. Are the notes on the sketch correct?



11 Cut cubes of the same size of carrot, turnip, potato, cheese, radish, celery, bread, apple, banana, onion and other food. Have a blindfold competition with your friends. First try

to tell which is which by feeling them. How many did you get right? Afterwards do the same for taste and smell. If you use small cubes, you will be able to give each person a new set for each test. (By the way, this makes a splendid party game. Try it at your next party.)

12 Eat a cube of apple while blindfolded and, at the same time, hold a pleasant smelling pear close to your nose. Again, bite a piece of raw potato and then a piece of raw onion with your nose tightly pinched. What does this experiment tell you about smell and taste?

13 The next time your eyes water, taste your tears. What does the taste most remind you of? Have you ever had perspiration run down your lip into your mouth? What does that taste like?

Things to remember

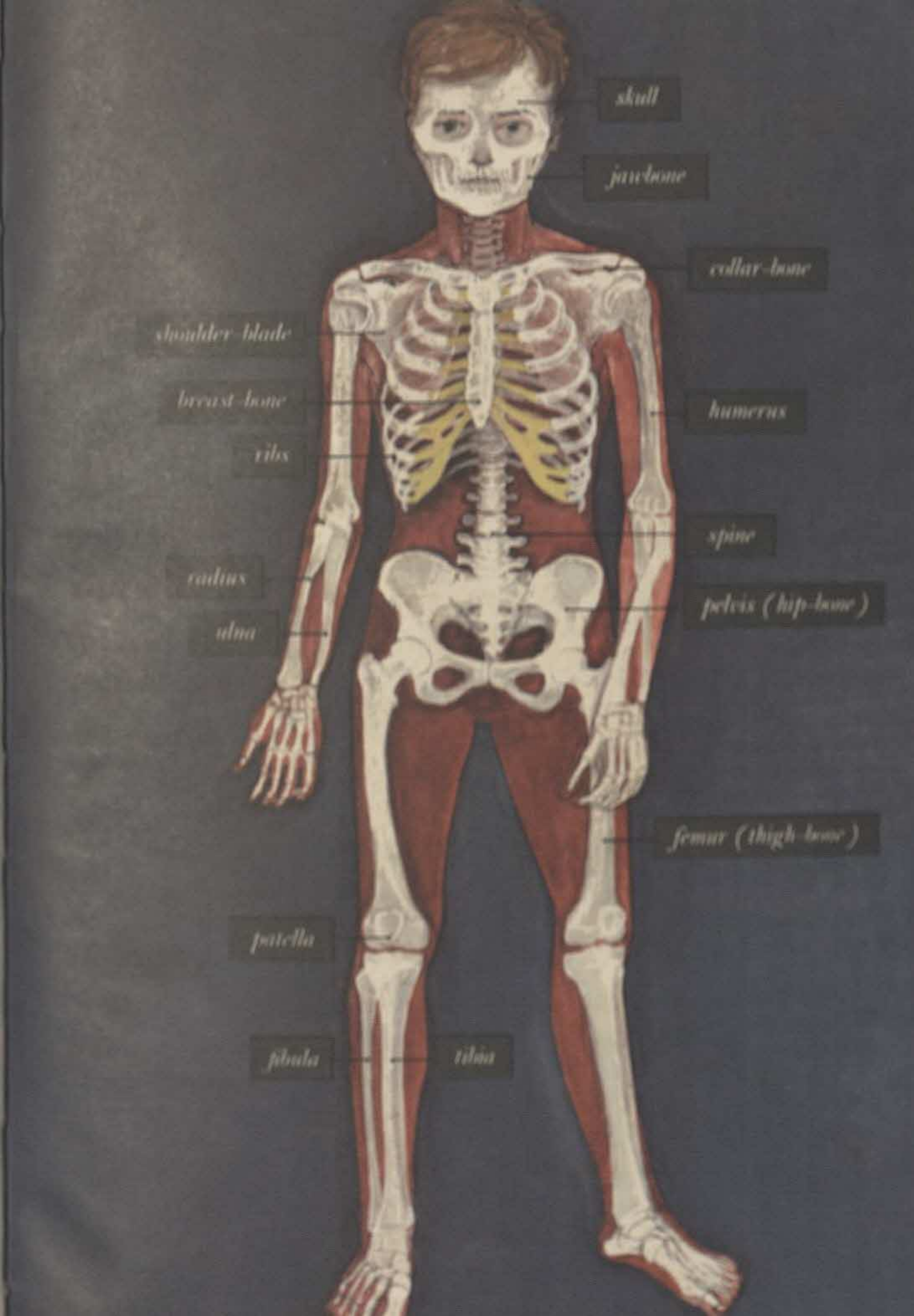
The bones of an animal or a human being allow movement to get food and to walk and play. The bones are joined by muscles which become longer and shorter in order to cause movement. The body has millions of nerves leading back to the brain and messages are sent backwards and forwards as our five senses (taste, smell, sight, touch and hearing) react to changes outside the body.

The blood is pumped round by the heart and returns to the lungs to get fresh oxygen. We call this the circulation of the blood.

To work well, the body must be kept clean inside and out. If germs enter the body, a healthy, clean body can fight and kill them. A dirty or lazy body can never be a good body. Cleanliness, fresh air, good food and exercise build up a healthy body. A healthy body is one of the most valuable blessings a human being can possess.

In your Science Notebook

1. Look in an encyclopaedia to find out how to include a chart of the human body in your notebook.
2. Put your own finger-prints in your notebook and say why detectives can use them to prove a criminal's guilt.
3. Write accounts of Experiments 11 and 12.
4. Try to find out what is meant by a balanced diet and write an account of your discoveries. Examine the menu for your school meals and comment on its balance.
5. Write an account of 'The Care of the Teeth' and collect drawings to illustrate your work.
6. Try to discover as many ways as possible in which germs can invade your home and school. Make a list of the precautions taken against germs.
7. Find out all you can about Harvey and his discovery of the circulation of the blood.
8. Arrange for a team of children to assemble a class reference book from the material you have each collected. Choose a good title for your book.


skull
jawbone
collar-bone
shoulder-blade
breast-bone
humerus
ribs
spine
radius
pelvis (hip-bone)
ulna
femur (thigh-bone)
patella
fibula
tibia

How much more have you learned? **Test three**

1. Write down the names of two things which (*a*) are heavier at the bottom than the top, (*b*) have wide bases.

2. Make two columns headed 'meat-eating creatures' and 'vegetable-eating creatures', and list the following correctly: tadpole caddis larva pond scorpion pond beetle pond snail water boatman pond worm stickleback minnow pond mussel

3. Make three drawings showing the larva, pupa and insect stages of any insect you have examined.

4. What things would you look for in order to place a creature in the insect family?

5. How can we distinguish between moths and butterflies?

6. Into what creatures do wireworms and leatherjackets turn?

7. Describe the life cycle of the cabbage white butterfly.

8. Rearrange the following so that they make sense:

a) A butterfly	can grow a new tail.
b) The larva	has a tongue like a spring.
c) A moth	can make a rope and climb up it.
d) An earthworm	has knobs on the tips of its feelers.
e) A slug	of the fly is called a maggot.

9. Put these words in the right places:
fish heavy light liquid
——— things float in water, but ——— things sink. Things float at different depths depending on the ——— in which they float. The shape of a submarine is copied from a ———.

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